September 11 and Stock Return Expectations of Individual Investors

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Abstract

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Keywords: Return Expectations, Volatility Forecasts, Overconfidence, Differences of Opinion, Confidence Intervals, Forecasting, Individual Investors, September 11

JEL Classification Code: D8, G1

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1 Introduction

Numerous studies analyze the reactions of markets and market participants to the releases of public information, such as earnings announcements.[1] However, little is known about how market participants react in a crisis situation with a high degree of uncertainty in connection with a large drop of share prices.

Our study offers the unique opportunity to analyze how an unprecedented crisis such as the September 11 tragedy influences expected returns and volatility forecasts of individual investors. Knowing which factors influence these forecasts is important as asset prices and portfolio allocations are driven by expectations of investors. Markowitz (1952) describes portfolio selection as a two step procedure. In the first step, investors have to form beliefs about the future performance of securities. The second step starts with these beliefs and ends with a portfolio choice. Sharpe (1964) assumes that investors think of returns of an investment in terms of a probability distribution and that they base their choices only on two parameters of this distribution: the expected value and the standard deviation.[2] These models show that expected return and the variance of assets are crucial for determining portfolio allocations or asset prices. But they are silent about the process of belief formation.

We asked a randomly selected group of individual investors with accounts at a German online broker to answer a questionnaire that we put on the internet. Among other questions

[1] See, for example, Daniel, Hirshleifer, and Subrahmanyam (1998) and Fama (1998) for a list of event studies. Kandel and Pearson (1995) analyze forecast revisions of stock brokerage research analysts and document differential interpretation of earnings announcements.

[2] Sharpe (1964), p. 428.

(belonging to another project, see Glaser and Weber (2003)), investors were asked to give a median estimate and upper and lower bounds of a symmetric 90 % confidence interval of the value of two German indexes and of the price of two German stocks at the end of the year 2001 (Deutscher Aktienindex DAX, Nemax50 Performance Index, BASF, Deutsche Telekom). Investors received an e-mail with the link to the questionnaire on Thursday, August 2, 2001. A second e-mail to the remaining investors who have not yet answered, scheduled five weeks later, was postponed due to the terror attacks of September 11 until Thursday, September 20, 2001. We refer to the group of investors who answered directly after the first e-mail as "first group" and to the group of investors who answered after the second e-mail as the "second group". The second group of investors answered exactly on the day with the lowest value of the German blue chip index DAX in the year 2001. Figures 1, 2, 3, and 4 present the charts of the four time series in the year 2001. The first vertical line in the respective chart indicates the date of response of the first group, the second vertical line shows the date of response of the second group.[3]

This paper offers the opportunity to study how a crisis situation that is accompanied by a large drop in share prices over a short time period of only several days affects estimates of expected returns and volatility forecasts of individual investors. In addition to forecasts of expected returns and volatilities we are able to analyze the level of disagreement among investors ("differences of opinion"[4]).

We do not answer the question what a rational prediction of stock prices or a rational

[3]The respondents to the first questionnaire had a forecast horizon of 21 weeks, respondents to the second questionnaire had a 14 week horizon.

[4]See Glaser and Weber (2003) for details on the "differences of opinion" literature.

reaction to the September 11 crisis should have looked like. The voluminous literature about rational expectations and econometric issues regarding predictions of time series and forecast evaluation tries to answer this question.[5] We study how the expectations of individual investors *change* in a crisis situation or after an event such as the terror attacks of September 11. We try to evaluate the plausibility of the answers of investors for example by comparing volatility estimates to historical volatilities as a crude benchmark. Unfortunately, we are not able to analyze whether the respondents of the second group actually traded stocks at the time of response. Due to an organizational restructuring, it was impossible to obtain transaction data from the online broker apart from the data set mentioned in Section 2.

This paper belongs to the strand of literature that examines the effects of the terror attacks of September 11 on financial markets and the economy as a whole. Graham and Harvey (2001, 2002) analyze, in a study close to ours, expectations of risk premia, as well as their volatility and asymmetry in a panel survey. On a quarterly basis, Chief Financial Officers (CFOs) of U.S. corporations are asked to provide their estimates of the market risk premium. One of these quarterly surveys was distributed on September 10, 2001. Some of the responses were received on September 10, 2001 via fax, others after the September 11 crisis. Graham and Harvey (2001, 2002) find that the estimate of the one year risk premium decreases sharply after September 11 whereas volatility forecasts increase. Poteshman (2003) analyzes whether there was unusual option market activity prior to the terrorist attacks of September 11, 2001. Anderson and Wagener (2002) analyze the impact of the September 11 crisis on expectations of future Euribor interest rates. Carter and Simkins

[5]See, for example, Diebold and Lopez (1996).

(2002) investigate the reaction of airline stock prices to the terrorist attacks. Straetmans, Verschoor, and Wolff (2003) answer the questions whether U.S. common stocks exhibit a higher propensity towards sharp declines and whether sharp drops in stock prices tend to co-move more frequently since Septmember 11. They do not find much support for a structural change in downside risk as measured, for example, by the Value-at-Risk. A special issue of the Economic Policy Review of the Federal Reserve Bank of New York (volume 8, number 2) analyzes economic consequences of September 11. Several authors discuss issues like economic costs (costs as direct consequences of the attacks as well as costs arising from efforts to prevent future attacks), the attacks' disruptive effects on the payments and securities settlement systems, and New York City's prospects after September 11. A special issue of the Journal of Risk and Uncertainty (Volume 26, Numbers 2/3) deals with the risks of terrorism with a special focus on September 11.

The main results of this paper can be summarized as follows. Return forecasts of the investors in our sample are significantly *higher* after September 11. The actual returns from the respective time of response until the end of the year 2001 are overestimated in both groups. The second group of investors states return forecasts that are approximately twice as high as the true realized returns. After the terror attacks, volatility forecasts are higher than before September 11. In two out of four cases, historical volatilities are *over*estimated. Therefore, investors are not generally overconfident in the way that they underestimate the variance of stock returns. Differences of opinion with regard to return forecasts are *lower* after the terror attacks whereas differences of opinion concerning volatility forecasts are mainly unaffected. Furthermore, differences of opinion are generally higher with regard to return (point) forecasts when compared to differences of opinion with regard volatility

forecasts.

The remainder of this paper is organized as follows. Section 2 describes the methodology of the study. Section 3 presents the results and the last section concludes.

2 Methodology

This study is based on an internet questionnaire that was part of a larger project (see Glaser and Weber (2003) for details). Approximately 3,000 randomly selected individual investors of a German online broker received an e-mail on Thursday, August 2, 2001 with a link to the online questionnaire. 129 investors answered around the following week-end. We call this group the "first group". The remaining group of investors received a second e-mail on Thursday, September 20, 2001. 86 investors answered around the following weekend. The group is called the "second group". Thus, we have a response rate of about 7 %, which is comparable to the response rates of similar questionnaires.[6] In what follows, we compare return and volatility forecasts of two separate groups of investors. The differences of findings in the two groups could, of course, be due to another reason besides September 11: The two groups of individual investors might be different not only in their estimate of, say, expected returns but also in various other dimensions which would make it difficult to argue that we have estimates of a homogenous group of investors in both groups. However, we are able to compare the two groups along various dimensions such as trading activity, portfolio positions, investment strategy, or demographic information.

Table 1 presents descriptive statistics of various characteristics (age, stock market invest-

[6] See, for example, Graham and Harvey (2002).

ment experience in years, information in hours per week, number of transactions in all security categories, number of stock transactions, mean monthly stock portfolio turnover, stock portfolio value in EUR, income in EUR of the two groups of respondents as well as the p-value of a Mann-Whitney test (Null hypothesis is that the two populations are from the same distribution). Furthermore, Table 1 presents the percentage of men and women, the percentage of investors who assess their investment strategy as high risk, and the percentage of warrant traders in both groups.[7] Table 1 shows that differences of the above mentioned characteristics in both groups are small and in most cases insignificant.[8] Only the mean monthly stock portfolio turnover, the stock portfolio value, and income are significantly different in both groups. The difference in the income variable is only marginally significant. Moreover, the income variable is only available for one third of all investors. Thus, the different turnover values of both groups seem to be the only important difference. Turnover is negatively related to the stock portfolio value.[9] Perhaps, online traders with higher turnover values who trade more often via internet also check their e-mails more often and thus answered directly after they received the first e-mail. The above mentioned results suggest that the two groups can be regarded as two random subsamples of the whole group of investors who received e-mails.

The investors were (among other questions) asked to give upper and lower bounds of 90 % confidence intervals to questions concerning stock market forecasts (Deutscher Aktienindex DAX, Nemax50 Performance Index, BASF, Deutsche Telekom) for the end of the

[7] See Glaser (2003) for further details on these characteristics.

[8] In addition, the whole group of the 215 investors who have answered either in August or September are not significantly different from the whole group of investors or the group of investors that have not responded to the questionnaire. See Glaser and Weber (2003) for details.

[9] See Glaser (2003) .

year 2001.[10]

The questions concerning return expectations were as follows:

> *For the following questions, please give three estimates each. The true answer to the questions (e.g. in the first question the value of the DAX at the end of this year) should...*
>
> | | |
> |---|---|
> | *Lower Bound:* | *...with a high probability (95 %) not fall short of the lower bound.* |
> | *Estimate:* | *...should equally likely be above respectively below your estimate.* |
> | *Upper Bound:* | *... with a high probability (95 %) not exceed the upper bound.* |

3 Results

3.1 Return Forecasts

In this subsection, we analyze the return point forecasts until the end of the year 2001 (i.e. over a horizon of 21 and 14 weeks, respectively) of individual investors. The investors were asked to state their median forecast of the value of two indexes (Deutscher Aktienindex DAX, Nemax50 Performance Index) and the prices of two German stocks (BASF,

[10]There was a fifth question which was a prediction concerning the future price of a stock which was a member of the Nemax50 index in the year 2001. This question was necessary for calculating the overconfidence score based on stock market forecasts in Glaser and Weber (2003). All results are similar to the predictions of the Nemax50. However, the time series of past prices is very short for this stock which makes it, for example, impossible to compare volatility estimates with historical volatilities. We therefore exclude the answers concerning price and volatility forecasts of this stock in this paper.

Deutsche Telekom) for the end of the year 2001. In the remainder of this paper, these four time series are indicated by the subscript i, $i \in \{1, 2, 3, 4\}$. We first transform these price or index value forecasts of individual k into returns[11]:

$$r(p)_i^k = \frac{x(p)_i^k}{value_i^{t_j}} - 1, \;\; p \in \{0.05, 0.5, 0.95\}, \;\; i \in \{1, 2, 3, 4\}, \;\; j \in \{1, 2\}, \;\; k \in \{1, \ldots, 215\}. \tag{1}$$

t_1 indicates August, 2nd, t_2 September, 20th.[12] $x(p)$ denotes the p fractile of the stock price or index value forecast, $r(p)$ denotes the p fractile of the respective return forecast with $p \in \{0.05, 0.5, 0.95\}$.

In line with the literature (see, for example, Kilka and Weber (2000)), we analyze two measures of return forecasts. Our first return forecast measure is the median divided by the value of the respective index or the price of the respective stock. We call this forecast the median return forecast.

According to Keefer and Bodily (1983), our next measure (henceforth mean return forecast) of time series i, $i \in \{1, 2, 3, 4\}$, for individual k, $k \in \{1, \ldots, 215\}$ is:

$$mean_i^k = 0.185 \cdot r(0.05)_i^k + 0.63 \cdot r(0.50)_i^k + 0.185 \cdot r(0.95)_i^k, \tag{2}$$

where $r(p)_i^k$ denotes the p fractile of the return distribution with $p \in \{0.05, 0.5, 0.95\}$.

[11] Some studies ask directly for returns, others ask for prices. Our method of elicitation was, among others, used by Kilka and Weber (2000) and Löffler and Weber (1997).

[12] The exact time of response is not available. Furthermore, we do not know whether investors answered Thursday night, or on Friday, Saturday, or Sunday. Thus, we use the Thursday closing price in both groups to calculate expected returns.

Keefer and Bodily (1983) show numerically that equation (2) serves as a good three-point approximation of the mean of a continuous random variable.

Table 2 presents the results of return point forecasts. The first observation is that the investors in both groups did not answer all questions concerning stock market predictions. For example, 115 of 129 investors, who answered the questions after the first e-mail, provided median as well as upper and lower bound of a confidence interval to forecast DAX returns. Focusing on the DAX forecast, the median of the mean DAX return forecast is ten times higher after September 11 than before. In the first group (time of response was August 2, 2001), the median across subjects is 5.14 % over the 21 week horizon until the end of the year 2001. In the second group the median of the return forecast is 56.52 %. A two-sided Mann-Whitney test (Null hypothesis: the two populations are from the same distribution) shows that the difference is highly significant ($p < 0.0001$). Similar results are obtained when we focus on the median return forecast.

These results do not coincide with findings of Graham and Harvey (2002) who analyze forecasts of the one year equity premium of CFOs. On September 10, the mean one year equity premium forecast was 0.05 % whereas the post crisis estimate was -0.70 %. The difference might be explained by the fact that the CFOs possibly answered at different days and perhaps only very few days after the terror attacks in a situation of high uncertainty.[13] Our subjects made their forecasts after large drops of stock prices until September 20, which was exactly the day with the lowest blue chip share prices in Germany in the year 2001 (see the German blue chip index DAX in Figure 1). In addition,

[13]The exact dates do not appear in the Graham and Harvey (2002) study. Furthermore, the U.S. stock exchanges closed until September 17 whereas the German stock exchanges remained open.

the results of Graham and Harvey (2002) are not significant due to the low number of observations. Shiller (1987) finds results comparable to ours after the stock market crash of 1987. He sent out questionnaires to individual and institutional investors at the evening of the day of the crash (October 19, 1987) and the following four days to better understand the causes of the crash and investor behavior in a situation of suddenly dropping share prices. One question asked investors whether they knew when a rebound was to occur. A surprisingly high 29.2 % of the individual investors answered "yes" in this unprecedented situation. Investors were thus pretty sure to know when the rebound was likely to occur. Furthermore, many individual investors stated "intuition" or "gut feeling" or just that they "knew there would be a rebound" as reasons for their conjectures.[14] Although we did not ask similar questions, the above mentioned findings by Shiller (1987) might present explanations for our findings of very high return forecasts after the terror attacks in our sample. The investors in our sample, like the investors in the Shiller (1987) sample, also seem to know when the rebound will occur. Their predictions suggest that they think the rebound will occur until the end of the year 2001. Unfortunately, we are not able to analyze whether the respondents of the second group actually bought stocks at the time of response. Due to an organizational restructuring it was impossible to obtain transaction data apart from the data set mentioned above.

Moreover, the investors in our sample are not completely wrong in their forecasts. When we compare the return forecasts with the actually realized returns until the end of the year 2001, we first observe that investors are optimistic about the future performance of stock prices in both groups. The actual return is overestimated by approximately 15

[14] Shiller (1987), pp. 12-13.

percentage points in the first group and by approximately 20 percentage points in the second group. However, the return forecast of the second group of about 56 % over the 14 week horizon is only 1.6 times the value of the actual return until the end of the year which was 35.45 %.

The remaining results of Table 2 show that the results concerning DAX return forecasts are robust. Similar results are obtained for the other three time series. The mean and median return forecasts of the investors in our sample are significantly higher in the second group. The actual returns are overestimated in both groups. The second group of investors states return forecasts that are approximately twice as high as the true returns.

Furthermore, column six of Table 2 shows that even the difference between the return forecasts of investors in both groups are about the same as the difference in the actually realized returns until the end of the year 2001 across the four time series. For example, the difference of the actual returns of the BASF stock from the respective time of response until the end of the year 2001 is 40.85 %. The difference of the return forecasts in both groups is about 43 %.

Why is the expected return for the Nemax50 in the second group about twice as high as the expected return for the DAX? The return of both indexes from September 10 until September 20 is similar (about -18 %). Accordingly, the drop in the values of the two indexes from September 10 until September 20 does not help to explain the high expected Nemax50 returns. Perhaps the returns of both indexes over the whole year 2001 until September 20 may serve as an explanation. Whereas the DAX "only" dropped by 40 % in this period, the Nemax50 almost crashed with a return of about -75 % (see Figure

1 and Figure 2). If investors expect mean reversion, these return differences might be an explanation for the higher expected return for the Nemax50: The lower the returns in the previous months, the higher individuals' return forecasts.

3.2 Volatility Forecasts

Table 3 presents estimations of the standard deviation or volatility of returns. The return volatility estimate of individual k, $k \in \{1, \ldots, 215\}$, for time series i, $i \in \{1, 2, 3, 4\}$, is calculated as follows (see Keefer and Bodily (1983)):

$$stddev_i^k = \sqrt{0.185 \cdot (r(0.05)_i^k)^2 + 0.63 \cdot (r(0.50)_i^k)^2 + 0.185 \cdot (r(0.95)_i^k)^2 - (mean_i^k)^2}, \quad (3)$$

with $mean_i^k$ as given in equation (2). $r(p)_i^k$ denotes the p fractile of the return distribution with $p \in \{0.05, 0.5, 0.95\}$. Keefer and Bodily (1983) show numerically that equation (3) serves as a good three-point approximation of the standard deviation of a continuous random variable.

The main (and perhaps unsurprising) result of Table 3 is summarized as follows. After September 11, the volatility forecasts are higher. A Mann-Whitney test rejects equality of volatility estimates for all four time series (all p-values are below 0.0001). These results are in line with the Graham and Harvey (2002) study. As volatility benchmarks we use several historical volatilities (volatilities of non-overlapping 21 week returns (column 3 of Table 3) and 14 week returns (column 4 of Table 3)).[15] Historical volatilities are often

[15] For the Nemax50 and Deutsche Telekom, there is only a very short time series of price data available. Therefore, we calculate historical volatilities until March 2003.

used as an objective volatility benchmark or an estimate for the future volatility.[16] Prior to the terror attacks the historical volatility of returns over the respective time horizons is underestimated in all four cases. This finding is in line with the overconfidence literature.[17] The term "overconfidence" summarizes many different phenomena: investors overestimate the precision of their knowledge, their probability estimates are often not well calibrated, they overestimate their ability to do well in the future, they think that they can control and predict random tasks, and they assess themselves as above average with regard to skills when compared to others.[18] Overconfidence is regarded as "perhaps the most robust finding in the psychology of judgment" (De Bondt and Thaler (1995), p. 389). Most behavioral models incorporate judgment biases into theories of financial markets by assuming that at least some market participants are overconfident in the way that they overestimate the precision of their knowledge or underestimate the variance of information signals. As a consequence, their confidence intervals for the value of a risky asset are too tight when compared to the rational benchmark. This assumption is in line with a variety of psychological studies that are often referred to as the "calibration" literature (see Lichtenstein, Fischhoff, and Phillips (1982)). Before September 11, investors in our data set underestimate the variance of stock prices which is consistent with the assumptions of overconfidence models. However, after the crisis, the historical standard deviation of returns is overestimated in two cases (DAX, BASF). In contrast, Graham and Harvey (2002) find volatility estimates of one-year risk premiums of 6.79 % prior to the terror attacks and 9.76 % afterwards compared to historical standard deviations of

[16] See, for example, Graham and Harvey (2002) and Siebenmorgen and Weber (2001).

[17] See Glaser and Weber (2003) and Glaser, Nöth, and Weber (2004) for a survey of the overconfidence literature.

[18] See, for example, Barucci (2003), p. 279.

one-year stock returns of 13.0 % (1980-2000) or 20.1 % (1926-2000) in the U.S.. In the cases of Nemax50 and Deutsche Telekom the historical volatility is underestimated. Note, however, the low number of past non-overlapping return observations of Nemax50 and Deutsche Telekom used in calculating the standard deviation of returns which makes the historical standard deviation as volatility benchmark questionable in these two cases.

In the case of the DAX, we are able to calculate the implied volatility over the respective forecast horizon using the German VDAX. The VDAX expresses the fluctuation range or implied volatility of the DAX index, as expected by the forward market.[19] Volatilities are quoted in annualized percentages. To calculate 21 week and 14 week percentages we multiply the VDAX values of August 2, 2001 and September 20, 2001 by $\sqrt{21/52}$ and $\sqrt{14/52}$, respectively.

The implied volatility of the DAX until the end of the year 2001 is 12.73 % at August 2, 2001 and 22.90 % at September 20, 2001. Thus, the DAX volatility estimates of the investors in our sample, especially the increase of the volatility estimate after the terror attacks seem to be reasonable. One interpretation of this result is that investors rationally expect a higher risk in the economy. In addition, it is reasonable that the DAX volatility estimate is the lowest volatility estimate in both groups followed by the BASF, Deutsche Telekom, and Nemax50 volatility estimate. BASF and Deutsche Telekom are members of the DAX index who contains 30 German blue chip stocks. An index is more diversified than a single stock that is part of the index. The index therefore has a lower volatility. Furthermore, BASF is a low risk value stock and Deutsche Telekom is a high risk telecom stock which suggests that BASF stock returns should have a lower volatility than

[19] See the description if the VDAX volatility index at www.deutsche-boerse.com.

Deutsche Telekom stock returns. Nemax50, the New Market index in Germany, is a high risk segment.

Unreported results show that the skewness of the return distribution given by the investors in our sample is unaffected by September 11. Furthermore, we asked the group of investors whether they own the stocks of BASF and Deutsche Telekom at the date of response. Note, that portfolio positions or transaction data are unavailable at the date of response of the investors. All the results concerning return and volatility forecasts presented in this paper are similar for investors who own or do not own the respective stock at the time of response. In addition, we find that investors who give higher return estimates, on average, also state higher volatility estimates. The investors in our sample, as a group, seem to understand the risk-return trade off.

3.3 Differences of Opinion

In this subsection, we especially focus on the level of agreement or disagreement among investors when interpreting publicly known events such as September 11. Does disagreement increase or decrease in a crisis situation? Besides the standard deviation of return and volatility forecasts across subjects we calculate a measure of differences of opinion. Such as in Diether, Malloy, and Scherbina (2002), differences of opinion (henceforth *dop*) are calculated as the standard deviation of the forecasts divided by the respective absolute value of the mean forecast. Diether, Malloy, and Scherbina (2002) analyze whether differences of opinion are related to the cross section of expected returns. They find that the higher their measure of differences of opinion (dispersion in analysts' earnings forecasts), the lower future returns of otherwise similar stocks.

Table 4 presents means of the mean and median return forecasts. Mean and median return forecast are defined in Subsection 3.1. Table 4 shows that the means of the return forecasts are similar in magnitude to the medians of the return forecasts presented in Table 2. The reason why we present the means of return forecasts in Table 4 (instead of the medians of the mean and median return forecast presented in Table 2) in addition to the standard deviation and our measure of differences of opinion is the fact that we scale the standard deviation by the absolute value of the mean forecast to calculate the *dop* measure.[20]

Table 4 shows that the standard deviation of forecasts across subjects is higher after September 11. However, when we scale the standard deviation by the absolute value of the mean forecast, Table 4 reports that differences of opinions *dop* concerning return forecasts are lower after the terror attacks. The differences of the *dop* measure of DAX return forecasts before and after the crisis are driven by the mean forecasts that are close to zero.

Table 5 shows the mean of the volatility forecast. Volatility forecasts are defined in Subsection 3.2. The means of the volatility forecasts are similar in magnitude to the medians as presented in Table 3. The standard deviation of the volatility forecasts are higher after the terror attacks. However, when we focus on the *dop* measure, the picture is less clear. The *dop* values are similar for both groups. For the DAX and the BASF stock the *dop* measure is slightly lower after September 11. In contrast, for the stock of Deutsche Telekom the *dop* measure is slightly higher after the terror attacks. For the New Market index Nemax50, the *dop* measure is equal in both groups. Thus, differences of opinion

[20] We use the exact value of the standard deviation rather than the rounded values reported in Table 4 to calculate the differences of opinion measure.

with regard to volatility forecasts are largely unaffected by the terror attacks whereas differences of opinion concerning return forecasts are *lower* after the terror attacks.

Furthermore, another interesting finding is presented by Table 4 and Table 5. Differences of opinion are generally higher with regard to return (point) forecasts when compared to differences of opinion with regard to volatility forecasts. This finding is interesting as it presents an empirical test of modeling assumptions in the "differences of opinion" and the "overconfidence" literature.[21] In both types of models, investors often receive noisy signals which are the sum of two random variables: the value of the risky asset and a random error term. Loosely speaking, "differences of opinion" models assume that investors disagree about the mean of the error term whereas investors in "overconfidence" models disagree about the variance of the error term.[22] Our results might be interpreted as an indication that modeling disagreement about mean returns has a better foundation in documented investor behavior than disagreement about the variance of returns. However, we note that this argument is speculation and needs further investigation.

4 Discussion and Conclusion

This paper analyzes stock return and volatility forecasts of individual investors before and after the terror attacks of September 11. Our main results can be summarized as follows:

1. Return forecasts are significantly *higher* after September 11 and the large drop in

[21] See Glaser and Weber (2003) for a discussion of these two strands of literature.

[22] Note, however, that underestimation of the variance of signals also creates heterogeneity of conditional means (differing posterior beliefs) that are driven by information (signal realizations), not by differing opinions concerning the mean of the prior (such as, for example, in Varian (1989)).

share prices after the terror attacks when compared to the return forecasts before the attacks.

2. After the terror attacks volatility estimates are in two out of four cases *higher* than the historical volatility of returns whereas before the terror attacks historical volatilities are always underestimated. Therefore, investors are *not generally* overconfident in the way that they underestimate the variance of stock returns.

3. Differences of opinion with regard to return forecasts are *lower* after the terror attacks whereas differences of opinion concerning volatility forecasts are mainly unaffected.

The higher volatility estimates of investors after September 11 might be a result of a rational anticipation of a higher uncertainty in the economy. However, a further explanation might be an anchoring and adjustment heuristic (see Tversky and Kahneman (1982)). A higher volatility might, at least in part, arise as investors first predict the value of an index or the price of a stock in the future. If they then build their confidence intervals by putting an interval with constant range around their point (or median) estimate, they will predict higher volatilities when stocks or indexes have lower nominal values as was the case after September 11.

Other reasons for deviations of forecasts in the two groups might be the different time horizons of the forecasts (21 versus 14 weeks) as both groups were asked to state end of the year prices. However, in our view, it is unlikely that the different time horizons will be a major driving force of our results. On the contrary, one would expect that, over a shorter horizon, return and volatility forecasts should, anything else equal, be *lower* for the second group. However, this is not the case. The driving forces of our results are the

September 11 tragedy and the drop of share prices in the days after the terror attacks.

One finding of this study is the high expected return until the end of the year 2001 of the second group of respondents. And, very striking, investors were not completely wrong: There was a strong rebound until the end of the year 2001. Perhaps, investors think that there will be a rebound - and that is the reason, why the rebound actually occurs.

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Table 1: Characteristics of the Two Groups of Respondents

This table presents descriptive statistics of various characteristics (age, stock market investment experience in years, information in hours per week, number of transactions in all security categories, number of stock transactions, mean monthly stock portfolio turnover, stock portfolio value in EUR, income in EUR) of the two groups of respondents as well as the p-value of a Mann-Whitney test (Null hypothesis is that the two populations are from the same distribution). Furthermore, the table shows the percentage of men and women, the percentage of investors who assess their investment strategy as high risk, and the percentage of warrant traders in both groups.

		First group	Second group	p-value (Mann-Whitney)
Respondents		129	86	
Age	Median	38	38	0.5603
	Mean	39.65	40.65	
	Standard deviation	9.34	10.60	
	Observations	115	68	
Investment experience (in years)	Median	7.5	7.5	0.6086
	Mean	5.39	5.55	
	Standard deviation	3.14	2.90	
	Observations	95	64	
Information (in hours per week)	Median	4	5	0.8573
	Mean	5.64	6.62	
	Standard deviation	4.81	8.38	
	Observations	129	85	
Number of transactions (all security categories) (Jan 1997 - Apr 2001)	Median	105	107.5	0.8535
	Mean	166.22	141.09	
	Standard deviation	225.52	135.59	
	Observations	129	86	
Number of stock transactions (Jan 1997 - Apr 2001)	Median	55	49.5	0.9856
	Mean	89.38	98.34	
	Standard deviation	109.53	124.09	
	Observations	125	80	
Mean monthly stock portfolio turnover	Median	0.36	0.28	0.0397**
	Mean	1.30	1.07	
	Standard deviation	4.21	3.97	
	Observations	122	77	
Mean monthly stock portfolio value (in EUR)	Median	13,139.87	20,897.84	0.0082***
	Mean	34,601.65	41,053.47	
	Standard deviation	123,173.30	67,075.18	
	Observations	125	77	
Income (in EUR)	Median	38,346.89	38,346.89	0.0946*
	Mean	48,012.14	59,559.38	
	Standard deviation	25,805.54	30,779.31	
	Observations	42	30	
Gender	men	94.57%	94.19%	
	women	5.43%	5.81%	
High risk investment strategy	Yes	12.40%	8.14%	
	No	87.60%	91.86%	
Warrant trader	Yes	44.19%	44.19%	
	No	55.81%	55.81%	

Table 2: Return Forecasts

This table presents medians of the mean and the median return forecast as well as the difference between the return forecasts of the two groups of respondents. Median and mean return forecast are defined in Subsection 3.1. In addition, the table shows the respective actually realized returns from the date of response until the end of the year 2001. The last column contains p-values of a two-sided Mann-Whitney test (Wilcoxon ranksum test). Null hypothesis is that the two populations are from the same distribution (return forecasts are equal in both groups).

			First group August 2, 2001 (1)	Second group September 20, 2001 (2)	Difference of returns (2)−(1)	p-value (Mann-Whitney)
DAX	Mean forecast	Median across subjects No. Observations	5.14 % 115	56.52 % 75	51.38 %	< 0.0001
	Median forecast	Median across subjects No. Observations	3.86 % 117	57.49 % 75	53.63 %	< 0.0001
	Actual return until the end of 2001		-10.68 %	35.45 %	46.13 %	
Nemax50	Mean forecast	Median across subjects No. Observations	23.19 % 111	95.30 % 74	72.11 %	< 0.0001
	Median forecast	Median across subjects No. Observations	18.92 % 113	100.24 % 74	81.32 %	< 0.0001
	Actual return until the end of 2001		-8.82 %	53.53 %	62.35 %	
BASF	Mean forecast	Median across subjects No. Observations	7.39 % 99	51.07 % 66	43.68 %	< 0.0001
	Median forecast	Median across subjects No. Observations	9.17 % 103	51.66 % 66	42.49 %	< 0.0001
	Actual return until the end of 2001		-8.62 %	32.23 %	40.85 %	
Deutsche Telekom	Mean forecast	Median across subjects No. Observations	10.07 % 108	58.46 % 73	48.39 %	< 0.0001
	Median forecast	Median across subjects No. Observations	11.99 % 112	56.15 % 73	44.16 %	< 0.0001
	Actual return until the end of 2001		-19.54 %	21.17 %	40.71 %	

Table 3: Volatility Forecasts

This table presents median volatility forecasts of the two groups of respondents for two German stock market indexes and two German blue chip stocks. Volatility forecasts are calculated as described in Subsection 3.2. In addition, the table shows historical volatilities of (non-overlapping) 21 week returns (column 3) and 14 week returns (column 4), respectively. For the Nemax50 and Deutsche Telekom, there is only a very short time series of price data available. Therefore, we calculate historical volatilities until March 2003. For the DAX, the table reports the implied volatility of the respective response date as well. These implied volatilities were calculated using the VDAX. The VDAX expresses the fluctuation range or implied volatility of the DAX index, as expected by the forward market. See Subsection 3.2 for details. Column 5 contains p-values of a two-sided Mann-Whitney test (Wilcoxon ranksum test). Null hypothesis is that the two populations are from the same distribution (volatility forecasts are equal in both groups).

		First group August 2, 2001	Second group September 20, 2001	p-value (Mann-Whitney)
DAX	Median across subjects	6.53 %	12.39 %	< 0.0001
	Number of Observations	115	75	
	Historical standard deviation (January 1988-time of response)	14.65 %	12.31 %	
	Implied volatility	12.73 %	22.90 %	
Nemax50	Median across subjects	18.49 %	33.74 %	< 0.0001
	Number of Observations	111	74	
	Historical standard deviation (January 1998 - March 2003)	39.94 %	41.48 %	
BASF	Median across subjects	6.97 %	14.43 %	< 0.0001
	Number of Observations	99	65	
	Historical standard deviation (January 1988 - time of response)	15.65 %	11.80 %	
Deutsche Telekom	Median across subjects	13.00 %	19.23 %	< 0.0001
	Number of Observations	108	73	
	Historical standard deviation (November 1996 - March 2003)	35.32 %	27.84 %	

Table 4: Return Forecasts: Differences of Opinion

This table presents means of the mean and median return forecast. Mean and median return forecast are defined as in Subsection 3.1. Furthermore, the table shows standard deviation of return forecasts as well as the differences of opinion. Differences of opinion (*dop*) are calculated as the standard deviation of the return forecasts divided by the respective absolute value of the mean return forecast.

			First group August 2, 2001	Second group September 20, 2001
DAX	Mean forecast	Mean	-0.0136	0.4360
		Standard deviation	0.18	0.29
		Differences of opinion *dop*	12.88	0.66
	Median forecast	Mean	-0.0087	0.4490
		Standard deviation	0.18	0.29
		Differences of opinion *dop*	20.19	0.65
Nemax50	Mean forecast	Mean	0.2972	0.9858
		Standard deviation	0.56	0.76
		Differences of opinion *dop*	1.89	0.77
	Median forecast	Mean	0.2878	0.9256
		Standard deviation	0.48	0.71
		Differences of opinion *dop*	1.68	0.77
BASF	Mean forecast	Mean	0.0311	0.4212
		Standard deviation	0.17	0.32
		Differences of opinion *dop*	5.58	0.75
	Median forecast	Mean	0.0340	0.4300
		Standard deviation	0.18	0.32
		Differences of opinion *dop*	5.27	0.74
Deutsche Telekom	Mean forecast	Mean	0.0862	0.5123
		Standard deviation	0.30	0.36
		Differences of opinion *dop*	3.46	0.71
	Median forecast	Mean	0.0931	0.5134
		Standard deviation	0.30	0.37
		Differences of opinion *dop*	3.21	0.71

Table 5: Volatility Forecasts: Differences of Opinion

This table presents the mean of the volatility forecast. Volatility forecasts are defined as in Subsection 3.2. Furthermore, the table shows standard deviation of volatility forecasts as well as the differences of opinion. Differences of opinion (*dop*) are calculated as the standard deviation of the volatility forecasts divided by the respective absolute value of the mean volatility forecast.

		First group August 2, 2001	Second group September 20, 2001
DAX	Mean	0.0743	0.1298
	Standard deviation	0.04	0.07
	Differences of opinion *dop*	0.57	0.52
Nemax50	Mean	0.2236	0.4014
	Standard deviation	0.16	0.28
	Differences of opinion *dop*	0.70	0.70
BASF	Mean	0.0911	0.1469
	Standard deviation	0.05	0.08
	Differences of opinion *dop*	0.56	0.51
Deutsche Telekom	Mean	0.1423	0.2283
	Standard deviation	0.07	0.14
	Differences of opinion *dop*	0.51	0.60

Figure 1: Chart of the DAX in the Year 2001

This figure presents the chart of the DAX in the year 2001. The first vertical line in the chart indicates the date of response of the first group (August 2, 2001), the second vertical line shows the date of response of the second group (September 20, 2001).

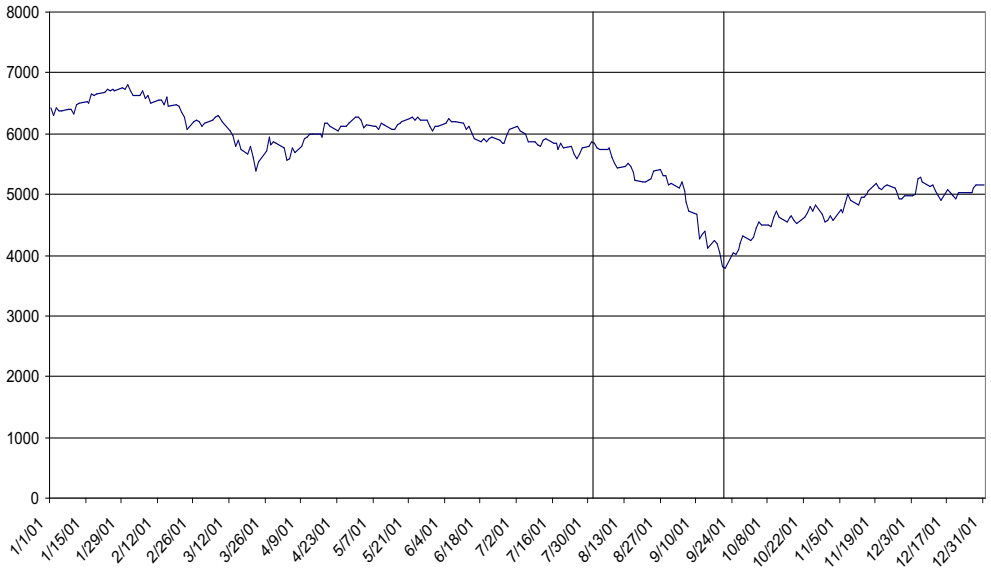

Figure 2: Chart of the Nemax50 in the Year 2001

This figure presents the chart of the Nemax50 in the year 2001. The first vertical line in the chart indicates the date of response of the first group (August 2, 2001), the second vertical line shows the date of response of the second group (September 20, 2001).

Figure 3: Chart of BASF in the Year 2001

This figure presents the chart of BASF in the year 2001. The first vertical line in the chart indicates the date of response of the first group (August 2, 2001), the second vertical line shows the date of response of the second group (September 20, 2001).

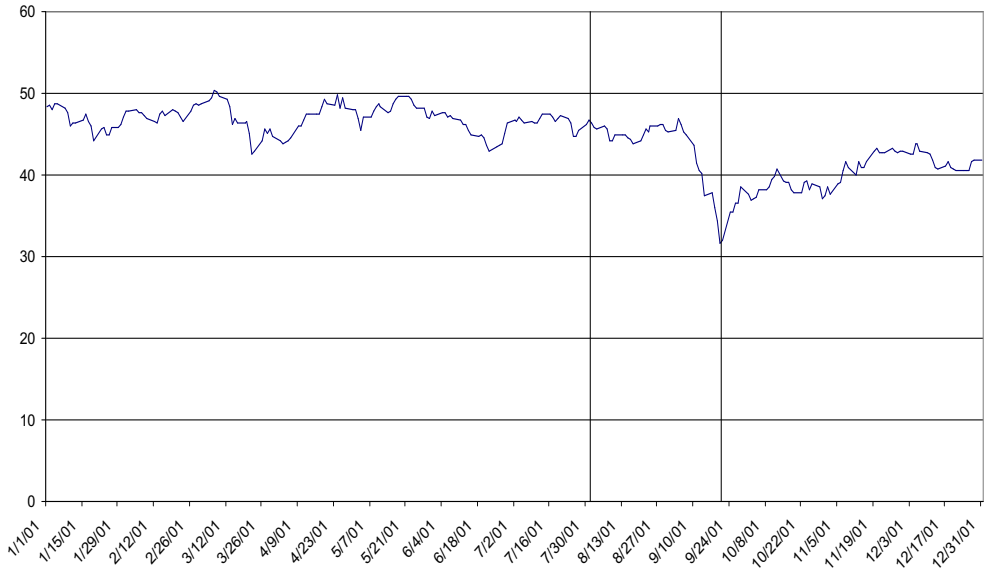

Figure 4: Chart of Deutsche Telekom in the Year 2001

This figure presents the chart of Deutsche Telekom in the year 2001. The first vertical line in the chart indicates the date of response of the first group (August 2, 2001), the second vertical line shows the date of response of the second group (September 20, 2001).