Stock Price Expectations and Stock Trading

Michael D. Hurd

RAND, NBER, NETSPAR and MEA

Susann Rohwedder

RAND and NETSPAR

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ABSTRACT

Background: The fact that many individuals inexplicably fail to buy stocks, despite the historical evidence for a good return on investment has been referred to as the stock market puzzle. However, measurements of the subjective probability of a gain show that people are more pessimistic than historical outcomes would suggest. Further, expectations of future stock price increases apparently depend on old information, which would seem to be at odds with rational expectations in the context of efficient markets. To shed light on these apparent paradoxes, we analyzed the relationships between actual stock market price changes and the subjective probability of price changes, and between the subjective probability of price changes and the likelihood of engaging in stock trading.

Approach: Drawing on 31 waves of longitudinal data on investment behavior from the American Life Panel surveys from November 2008 to the present, we tracked high frequency changes in expectations at the individual level and related them to high frequency changes in stock market prices. We analyzed both individuals who held stock in retirement accounts and those who held stocks outside of these accounts.

Results: Changes in the subjective probability for one-year and 10-year gains in stock prices correlated with the Standard and Poor 500 Index with lags ranging from changes during the most recent week to changes more than a month before. This relationship was stronger among those who professed to follow the stock market and to have good knowledge than among those whose understanding is poor. Among individuals who held stock outside of retirement accounts, the likelihood of buying and selling stock was more strongly associated with recent stock behavior than among those who held stocks only within retirement accounts.

Conclusions: On average, subjective expectations of stock market behavior depend on stock price changes. Furthermore, stock trading responds to changes in expectations even when the change in expectations was several weeks before the trade. These results suggest that expectations and trading are related to stock price changes in an intertemporally complex manner. Our findings also confirm that expectations about stock market gains are pessimistic, which would imply that many people simply view savings accounts as a better investment. We conclude that we need a better understanding of expectation formation and how those expectations are translated into choice.

INTRODUCTION

According to the efficient markets hypothesis, no currently available information will predict future market prices: If information had systematic predictive power, traders would base their trading decisions on that predictive power, which would result in an adjustment of current prices that would divest any further predictive power from the information. In particular, the hypothesis asserts that lagged changes in stock prices should have no power to predict future stock price changes. An implication of this hypothesis is that stock prices should follow a random walk with drift, that is, over time, they will follow a trend on average, but in the short-term, they will change unpredictably. According to the theory of rational expectations, the probability distributions of future prices for informed traders will come to coincide with the actual distribution of stock price outcomes as the traders learn of the processes generating stock prices. An implication of both efficient markets and rational expectations is that informed traders' expectations of price increases should not depend on currently available information, particularly lagged changes in stock prices.

These considerations have led to the stock holding puzzle, that is, the inability to explain why individuals fail to buy stocks, despite the historical evidence for a good return on investment (Halliassos and Bertaut, 1995). Rational expectations would predict that people should come to believe the stock market evolves as a random walk with drift, where the mean and variance of stock prices are given by historical rates of return in the stock market. However, the expected value and variance of those rates are such that there is no reasonable explanation for why stock holding is far from universal. The most prominent explanation is that people are extremely risk averse. Other explanations have included (large) fixed costs of entering the market, inertia, and minimum investments. However, none of these explanations appears to be sufficient to explain the widespread lack of stock holding.

Nevertheless, direct measurements of the subjective probability of a gain in the stock market show that people are more pessimistic than historical outcomes would suggest. For example, Dominitz and Manski (2011) report that, as elicited in 2002-2003, the average subjective probability of a gain over the next year is just 46 percent. Taken at face value, on average, people anticipate that in replicates of the coming year, stock prices will be higher in 46 percent of those years and lower in 54 percent. Were this average to be an accurate representation of the historical probability of a one-year gain, the average should be about 73 percent (Kezdi and Willis, 2008). In the 2002 wave of the Health and Retirement Study (HRS), the average subjective probability was 49 percent (Kezdi and Willis, 2008). The average subjective probability of a one-year gain was 42 percent among Dutch households in 2004 (Hurd, van Rooij and Winter, 2011), yet the historical frequency between 1983 and 2008 suggests the average based on rational expectations should have been 68 percent. Furthermore, the average subjective probability of a gain seems to be related to recent stock market experience (Hurd, 2009). For example, Hudomiet, Kezdi, and Willis (2011) have found that prior to the stock market crash of 2008, the subjective probability of a one-year gain was significantly related to the change in the Dow Jones average over the previous month. Such dependence of expectations on old information would seem to be at odds with rational expectations in the context of efficient markets.

To shed light on this apparent paradox, we have conducted a set of analyses. Drawing on 31 waves of data from monthly panel surveys from November 2008 to the present that contain observations on the subjective probability of stock market price increases and decreases and on stock trading, we have tracked

high frequency changes in expectations at the individual level and related them to high frequency changes in stock market prices. Because our data come from a time of high volatility, we obtain substantial variation in stock prices, which helps with the precision of estimation. Most importantly we are able to relate changes in stock price expectations to trading behavior at the household level. To the best of our knowledge, this study is the first to use micro data to estimate the effect of stock market expectations on trading.

The Great Recession

According to the Case-Shiller 20-City Average Home Price Index, housing prices peaked in May 2006. Problems in the housing market associated with the subsequent decline in prices and with the relaxed lending standards during the run-up in prices spread to the financial sector, which led to the financial crisis. At the beginning of the crisis, the unemployment rate was quite low: In December 2007 when the economy entered the recession, the rate was just 5 percent. However, housing prices continued to decline, and in October 2007, stock prices, which had been increasing as measured by the S&P500, began to decline. By October 31, 2008, the S&P500 was down 37 percent from a year earlier. The Case-Shiller Index was down 18 percent from a year earlier. In September 2008, the unemployment rate was 6.2 percent, but the increase was still modest relative to other problems associated with the financial crisis. However, in October 2008, the unemployment rate increased to 6.6 percent, in November it rose to 6.9 percent, and by December it had risen to 7.4 percent. In the month of October 2008, the S&P500 dropped an additional 17 percent, prompting us to launch the Financial Crisis Surveys among participants in the American Life Panel. The first survey was fielded at the beginning of November 2008. The next survey followed three months later in February 2009. Since May 2009, we have collected in the RAND American Life Panel monthly data on the same households.

The RAND American Life Panel

The RAND American Life Panel (ALP) is an ongoing Internet panel survey of about 2500 persons, 18 and over, operated and maintained by the RAND Corporation's Division of Labor and Population.[1] Panel members were initially recruited from respondents to the University of Michigan Survey Research Center's Monthly Survey (MS) between 2002 and 2008. At the end of an MS interview, respondents were asked to participate in the ALP; about 80 percent of respondents agreed to participate. Those who do not have access to the Internet are provided with a Web TV (www.webtv.com/pc/), including an Internet access subscription with an e-mail account. Post-stratification weighting results in a weighted respondent pool that approximates the distributions of age, sex, ethnicity, education, and income in the Current Population Survey. Several times a month, respondents receive an email request to visit the ALP website to complete questionnaires. Respondents are paid an incentive of about $2.50 per minute of survey time. Response rates are typically between 80 and 95 percent of the enrolled panel members, depending on the topic, the time of year, and how long a survey is fielded.

The ALP has conducted many longitudinal surveys of its respondents, so that over time it has collected data on a wide range of covariates. For example, ALP respondents have been asked about their financial knowledge, their retirement planning, and hypothetical questions designed to reveal parameters such as risk aversion. In addition, they have been given the survey instrument of the Health and Retirement Study in modules, one at a time over an extended period. As a result, we have collected their responses to the wide range of HRS health queries and to the HRS cognitive battery.

[1] The ALP is in the process of expanding to about 5000 households

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The Financial Crisis Surveys

The very large stock market declines in October 2008 prompted our decision to begin collecting data on responses by member of the ALP to the financial crisis The first two surveys, administered to the ALP in November 2008 and February 2009, covered a broad range of topics, including various dimensions of life satisfaction, self-reported health measures and indicators of affect, labor force status, retirement expectations, recent actual job loss and chances of future job loss, housing, financial help (received and given and expectations about these), stock ownership and value (including recent losses), recent stock transactions (actual and expected over the next 6 months), expectations about future stock market returns (one year ahead, 10 years ahead), spending changes, credit card balances and changes in the amounts carried over, impact of the financial crisis on retirement savings; and expectations about future asset accumulation.

Beginning with the third interview in May 2009, we transitioned to a monthly survey schedule to reduce the risk of recall error and to collect data at high frequency on items such as employment, satisfaction, mood, affect, spending, expectations, and stock trading behavior. An objective was to permit detailed sequencing of events and their consequences.[2]

Between November 2008 and September 2011, a total of 2,693 respondents participated in at least one of the 31 interviews. The retention rate in the panel interviews has been high: 70.8 percent (N=1,906) responded to 20 or more out of 31 interviews.[3] We attribute the high retention rate, in part, to our inviting respondents to continue to participate in the surveys even if they miss one or more of the interviews. In this paper, we use data from the 31 surveys covering the period November 2008 through September 2011.

Subjective Probability of Stock Market Gain

We used our surveys to elicit expectations of stock market gains by including questions about the subjective probabilities of such gains. To inquire about *any* gain, we asked the following question:

> On a scale from 0 percent to 100 percent, where "0" means that you think there is absolutely no chance, and "100" means that you think the event is absolutely sure to happen, what are the chances that by next year at this time mutual fund shares invested in blue chip stocks like those in the Dow Jones Industrial Average will be worth more than they are today?

[2] To further reduce recall error the survey is available to respondents only for the first 10 days of each month, except when the first day of the month falls on a weekend. Then the schedule is shifted by a day or two to accommodate staff work schedules.

[3] After wave 14, collected in April 2010, we had to reduce the sample due to budgetary constraints. For that purpose we excluded the most sporadic of respondent to that date, i.e. those who had answered less than five out of the 14 surveys. The response rates reported here do not adjust for the subsequently smaller eligible sample. The response rate of participating in 20 or more surveys would be 83% if we excluded from the denominator those respondents who were excluded from the surveys after wave 14.

This question was followed by a similar question, but with a target gain of 20 percent or more, and then by a question with a target loss of 20 percent or more. Since 1992, the HRS has used this format as the standard one for eliciting subjective probabilities, and the same format has been followed by its sister surveys such as the English Longitudinal Study of Ageing and the Survey of Health, Ageing and Retirement in Europe

Updating of Stock Market Expectations

The updating of stock market expectations based on recent stock market price changes would seem to be an example of Bayesian learning. We developed a simple model to provide guidance about the empirical specification of how stock price changes might affect expectations.

Let s_t be the stock market price at time t and let $y_t = \ln\left(\frac{s_{t+1}}{s_t}\right)$ be the rate of return from *t* to *t*+1.

Suppose that s_t evolves according to

$$\ln\left(\frac{s_{t+1}}{s_t}\right) = \alpha + v_t,$$

where α is the unchanging long-term rate of drift in stock prices and v_t are i.i.d. $N(0,\sigma^2)$.[4] Thus stock prices follow a random walk with drift α per time period. Assume that the variance of v_t is unchanging. An observer of the stock market seeks to learn the laws governing the rate of return by combining observations on y with prior information.

Let the prior distribution held by an individual be $\alpha: N(\theta,\xi^2)$. Then the posterior distribution of $\alpha \mid y_t$ is normal with mean $ay_t + (1-a)\theta$ and variance

$$\frac{\xi^2\sigma^2}{\xi^2+\sigma^2}$$

where

$$a = \frac{\xi^2}{\sigma^2+\xi^2}$$

These considerations suggest an empirical specification of updating such as $E(y_{t+1} \mid y_t) = c + \beta y_t$. However they also point out some weaknesses of this simple approach. The first is that if the stock

[4] Hurd, van Rooij and Winter (2011) find that using a nonparametric distribution for α rather than a normal distribution produces similar results.

market is a stationary process, then individuals will use multiple observations on y in forming their posterior distribution of α. Let $\bar{y}_t$ be the mean of n independent observations of y. Then, $\bar{y}_t$: $N(\alpha, \sigma^2/n)$ and

$$\alpha \mid \bar{y}_t : N(\bar{a}\,\bar{y}_t + (1-\bar{a})\alpha, \frac{\xi^2\sigma^2/n}{\xi^2 + \sigma^2/n})$$

where $\bar{a} = \frac{\xi^2}{\sigma^2/n + \xi^2}$. As n becomes large, $\bar{a}$ goes to one and the posterior variance of α goes to zero. The posterior distribution of α collapses to the point $\bar{y}_t$. An implication is that for sufficiently large n there should be little, if any, updating, which seems to be at odds with the empirical observations cited in the introduction. A further implication is that all individuals should have the same posterior distribution for α even if they began with different prior distributions. However, identifiable groups have different average expectations of stock market gains: for example, men have more optimistic expectations than women, and stock owners have more optimistic expectations than those who do not own stocks (Hurd, van Rooij and Winter, 2011; Hudomiet, Kezdi, and Willis, 2011). Thus, although we will base our estimations on forms such as $E(y_{t+1} \mid y_t) = c + \beta y_t$, we anticipate that some data elements will suggest a more complex process of expectation formation.

RESULTS

Figure 1 shows the average subjective probability for one-year and ten-year gains in the stock market (right vertical axis), compared with the actual S&P 500 (left vertical axis) over the course of the 31 interviews from November 2008 (interview 1) to September 2011 (interview 31), recalling that the second interview occurred in February 2009, the third in May 2009, and the remainder occurred monthly thereafter. As the figure shows, the S&P500 experienced a general increase, but with considerable volatility. In contrast, the average subjective probability that the stock market would increase over the next year was less than 50 percent—suggesting pessimism among the respondents. Over the course of the survey period, this figure changed relatively little or declined slightly. The average subjective probability that the stock market would be higher in 10 years (that is, the subjective probability of a 10-year gain) started out slightly higher but showed a slow decline over the three years of the survey, indicating increasing pessimism about long-term prospects.

Figure 2 shows three points on the cumulative distribution of the average subjective probabilities for one-year rates of return at each interview. The top line shows the average subjective probability that the one-year gain will be less than +20 percent. The middle line shows the average subjective probability that the gain will be less than zero. The bottom line shows the probability for an actual loss of greater than 20 percent. The only notable trend among these data is that over time, respondents increasingly believed that one-year rates of gain would not exceed 20 percent.

Closer examination of the data in Figure 1 revealed the possibility that a peak in the S&P 500 at a particular wave (e.g., wave 1) might be followed by a peak in the subjective probability of a one-year gain (e.g. wave 2). This relationship can be seen more clearly in Figure 3, which shows the month-to-month differences in the subjective probability of a one-year gain, superimposed on the monthly percent change

in the S&P 500. The figure shows a fairly clear pattern of month-to-month changes in the S&P 500 accompanied by month-to-month changes in the subjective probability of a one-year gain.

To investigate this potential association more formally, we compared the month-to-month changes in the subjective probability of a one-year gain (in percentage points) with the percent changes in the S&P 500. Figure 4 shows a scatter plot of the change in the subjective probability of a one-year gain (on the vertical axis) and the change in the S&P 500 (on the horizontal axis), revealing a strong positive relationship: The fitted line from the regression of the change in the subjective probability of a one-year gain on the change in the S&P 500 has a slope of 0.17 (standard error [SE], 0.03; $R^2 = 0.47$). These results suggest that if the S&P 500 were to increase by 10 percent in a month, the subjective probability of a one-year gain would increase by 1.7 percent or 0.017 in probability. Based on an average value of the subjective probability of a one-year gain of 40 percent or 0.40 in probability, this increase in the average probability would be 4.25 percent. During the period covered by our surveys, the largest one-month gain was 11 percent (July to August 2009), and the largest one-month loss was -8 percent (July to August 2011) so the posited value is within the range of observations.[5] This result strongly supports the idea that individuals update their anticipations of change in the stock market based on recent change in the stock market.

Prior research has shown that stock holders have more optimistic expectations about stock market gains than do those who do not hold stocks (Kezdi, Willis, 2007). Stock holders are also likely to be more reactive to changes in the price of stocks than non-stock holders simply because they pay more attention to the stock market than others do. Using our survey data to compare the average subjective probabilities between stock holders and non-holders, those who claimed to follow the stock market and those who did not (according to their self-assessment), and those who professed knowledge about stocks and those who professed little or no knowledge confirmed these findings (Table 1). First, when the average subjective probabilities were averaged over all waves, stock holders reported an average subjective probability of a one-year gain of 46.9 percent compared with just 33.5 percent among non-holders. Second, the regression of the change in the subjective probability of a one-year gain is 0.221 (SE 0.041) among stock holders and just 0.112 (SE 0.060) among others. Thus, compared with non-holders, the reaction of stock holders to recent changes in stock prices is quantitatively large and statistically significant.

Table 1 also shows similar results for comparisons between followers of the stock market and those who do not and among those who professed to understand the market well, a little or not at all. Large differences were observed between those who professed to follow the market and those who did not in the average subjective probability of a one-year gain, but no difference was seen in the reaction to stock market changes. Respondents with better understanding of the market also reported higher average subjective probability of a one-year gain and reacted most strongly to stock market changes. Thus, we find that the average subjective probability of a one-year gain varies with observable characteristics that are associated with investment or interest or expertise in the stock market, but the reaction to recent changes in the stock market also varies with those same characteristics.

[5] The largest gain in Figure 4 (19%) was over the two-month period March 2009 to May 2009 and the largest loss -17%) was over the four-month period November 2008 to March 2009.

Thus far, we have presented results based on the subjective probability of a one-year gain because they are directly reported by respondents. However, the scaling of these data is not comparable with the change in stock market prices, which is our main explanatory variable. Rather, we would like to compare the change in the S&P 500 to an expected rate of return. In addition, the subjective probability of a one-year gain does not reflect all the information about expectations concerning the stock market that were elicited from respondents, such as the chances of a gain greater than 20 percent or a loss of more than 20 percent. We estimated an expected one-year rate of return for each respondent using the three points on the subjective probability distribution of the one-year rate of return shown in Figure 2. From these three points, we have data on the subjective probabilities over the following four intervals: <-20 percent, -20 percent to zero, zero to 20 percent, >20 percent. We calculate the expected rate of return as

$$E(r) = \sum_{j=1}^{4} P(r \in I_j) E(r \mid r \in I_j)$$

where $E(r \mid r \in I_j)$ is the historical average one-year rate of return in the S&P 500 conditional on the rate being in interval j. According to these calculations $E(r)$ averaged –0.1 percent over the period of our surveys, and the average varied between 0.8 (November, 2009), and –1.5 percent (September, 2011). While the two series are highly correlated (correlation coefficient = 0.81), they differ because of trends on the probabilities that the rate of return will be in the tails. For example the probability that the rate of return would be greater than 20 percent declined from about 0.30 to 0.22 over the 35 months of the surveys. Figure 5 shows the evolution of $E(r)$ (right vertical axis) and the S&P 500 (left vertical axis). $E(r)$ was mostly positive until wave 16 (June 2010), when it declined to zero and then into the negative in subsequent waves.

As with the subjective probability of a one-year gain, $E(r)$ shows peaks and troughs that appear to coincide with those of the S&P 500. Figure 6 shows the scatter plot of the month-to-month change in $E(r)$ on the vertical axis and the month-to-month change in the S&P 500. The figure also shows a fitted line for the change in $E(r)$ from the regression of $E(r)$ on the change in the S&P 500 with a slope of 0.081 (SE, 0.010), $R^2 = 0.70$). Thus, if the S&P 500 increases by 10 percent over a month, the expected rate of return will increase by 0.81 percent.

Lags in the change in stock prices

Our data show a strong relationship between changes in stock prices and changes in the anticipated rate of return over the subsequent year. Thus we were interested in investigating the timing of the change in expectations, to assess whether the observed relationships could be due to reactions to very short-term changes in the S&P 500, say within several days of the interview, or to changes over weeks or months.

To examine the timing involved in the change in expected rates of return, we performed a regression of the month-to-month change in the subjective probability of a one-year gain on changes in the S&P 500 calculated over a number of seven-day intervals preceding the survey. Table 2 shows the time intervals over which changes in the S&P 500 are calculated: The first lag is from seven days prior to the survey to the day before the survey; the second lag is from 14 days prior to eight days prior; and so forth. Additional variation in the right-hand variables comes from variation in interview day: Because each

wave is available from the first of the month to the tenth of the month, different individuals will have different values for all the lags in the changes in the S&P 500, even in the same month.

For the group that included all respondents, the regression coefficients were statistically significant for six out of the eight lag periods. Examining the regression coefficients over increasingly longer lag times, a pattern emerged. The coefficients increased for the first three weeks, then underwent a decline at days 22-28, declining more sharply at days 29-35, which coincides with overlap between the lags in the right-hand variable and lags in the left-hand variable. Because the left-hand variable is the one-month change, the 29-35 day lag (four-week lag in the change in the S&P 500) would have affected the one-month-ago level of the subjective probability of a gain, thus affecting the change in subjective probability in a different manner from the shorter lags. For example, an increase in the S&P 500 over days 29-35 would have increased the reported subjective probability as reported in the preceding survey. Then the change in the subjective probability from the last survey to the present survey would be reduced, causing a negative relationship between the change in the S&P 500 over days 29-35 and the change in the subjective probability from last month to the present month.

The sum of the coefficients for the first four lags is 0.81, which is consistent with the slope in Figure 4. If the S&P 500 increased by 1 percent each week, it would have increased by about 4.2 percent over a month: Figure 4 would predict a change of 0.71 over a month, marginally below 0.81.

Table 2 also shows separate regressions by interest or expertise in the stock market. Comparing regression coefficients for stock owners with those of non-owners, we see fewer significant coefficients among non-owners. In addition, the magnitudes of the sums of the regression coefficients for the first four lags were generally larger among the owners than among the non-owners: 0.89 vs. 0.68. Among those who professed to follow the stock market and to have good knowledge, the sum of first four coefficients was 1.08, compared with 0.57 among those who do not follow the stock market and whose understanding is poor.

Table 3 shows similar results except that the left-hand variable is the change in the expected rate of return over the next year from one wave to the next. These data show that if the S&P 500 increased by one percent in the week before the interview, the expected one-year rate of return would increase by 0.103 percent. Over the sample period, the maximum one-week increase was 11 percent and the maximum decrease was 13 percent, a variation that would have resulted in a change in the expected one-year gain of about 2.4 percentage points. As with the subjective probability, stock owners were more responsive than non-owners (0.47 vs. 0.35 for the sum of the first four coefficients). Among those who professed to follow the stock market and to have good knowledge about it, the sum of the coefficients was 0.53, compared with just 0.23 among those who do not follow the stock market and whose understanding is poor.

Stock Price Expectations and Stock Trading

Thus far, we have examined the relationship between changes in stock prices and the subjective probability of stock market gains. We then wanted to understand whether these subjective probabilities actually affected (or were at least associated with) respondents' economic decisions. Specifically, we were interested in whether a change in subjective probability resulted in a change in respondents' likelihood of entering or exiting from the stock market.

Stocks can be held in two ways: as part of a retirement account portfolio or outside of a retirement account. We queried respondents quarterly about stock ownership both inside and outside of retirement accounts, and based on these data, we related transitions into and out of stock ownership to changes in the subjective probability of a one-year gain in the stock market. We did this via logistic regression, where the left-hand variable indicates whether a transition in ownership took place and the right-hand variables are month-to-month changes in the subjective probability of a one-year gain or loss in the stock market. For example, we examined whether we could explain transitions out of the stock market between the January survey and the April survey using the change in the subjective probability of a one-year gain between March and April, between February and March, and between January and February.

Table 4 shows the results of the logistic regression of the effects of monthly changes in the subjective probability of a one-year gain for transitions from stock ownership to non-ownership. The average probability of that transition averaged over nine quarters or eight transitions was 0.086. Each of the lagged changes in the subjective probability of a one-year gain had a statistically significant effect on the likelihood of leaving the stock market, although these effects were modest. For example, a 10 percentage point increase in the subjective probability of a one-year gain is estimated to reduce the probability of leaving the stock market by 0.0071. The interquartile range of the monthly change in the subjective probability of a gain is 20 percentage points, which would imply a differential in the probability 0.0142, about 17 percent of the average probability of quitting the stock market (8.6 percent). Were the subjective probability of a one-year gain to increase by 10 percentage points in each of the three months in the quarter, the effect would be the sum of the coefficients on the lagged changes, which would be 0.034. Although this change in probability is large, the change in the right-hand variables is also large. The last regressor is the level of the subjective probability of a one-year gain at the previous quarter. The coefficient indicates that independent of the change in the subjective probability, respondents were less likely to leave the stock market when their subjective probability was optimistic, although the effect is modest.

We also assessed the effects of monthly changes in the subjective probability of a one-year gain for entering the stock market, that is, the transition from stock non-ownership to ownership or continued non-ownership (Table 5). This logistic regression provided similar results. The average transition probability into ownership over a quarter was 0.111. Although all the coefficients are significant, the effects of the right-hand variables are modest: An increase in the preceding month in the subjective probability of a one-year gain in the stock market of 10 percentage points is associated with an increase in the probability of the transition of 0.0074.

Monthly data on stock trading

Whereas we have only quarterly data on stock holdings, both within and outside of retirement accounts, we have monthly data on stock trading. As the next step in our study, we analyzed data first on trading outside of retirement accounts and then on trading within retirement accounts. Our hypothesis was that responses would differ between the groups, and that, on average, owners of stock shares within retirement accounts would be likely to be more passive with respect to buying and selling. For example, some individuals become owners of shares in retirement accounts or in life-cycle funds that partially invest in stocks only because those are the options offered by their retirement plans. Such individuals might show little response to changes in expectations.

Table 6 shows the level of—and the one month change in—the one-year probability of a gain classified by the type of stock trading, for individuals holding stocks outside of retirement accounts. Thus, among those who bought only during the previous month, the average subjective probability of a stock gain was 52.8 percent, and the change in the probability of a gain was 1.1 percent. Among those who sold only, the average subjective probability of a gain was 48.4 percent and the one-month change was 0.1 percent. Of course, some respondents both bought and sold. We asked whether they bought more than they sold or the reverse. Among the net buyers, who are more active participants and thus are more likely to follow the stock market and to have expectations that inform decisions, the average subjective probability and the change in the subjective probability were the highest among the groups in the table. Finally, those who neither bought nor sold accounted for 91 percent of the sample and had by far the most pessimistic expectations. Overall, Table 6 suggests a consistent relationship between trading and the level of and change in price expectations.

We performed a logistic regression, where level 1 corresponded to individuals who sold only or sold more than they bought; level 2 corresponded to individuals who neither bought nor sold; and level 3 corresponded to those who bought only or bought more than they sold. Coefficients on both the previous month's level and the change since the previous month are statistically significant: A 10 percentage-point increase in the subjective probability of a one-year gain increased the probability of buying by 0.0057, which we would characterize as a modest effect (Table 7).

We then repeated the same analyses for individuals who held stock only in retirement accounts. Table 8 shows the level of—and the one month change in—the one-year subjective probability of a gain, classified by the type of stock trading.

Among those who, during previous month, had only bought, we saw that the level of subjective probability was high but declined 0.9 percentage points during the month. Those who had only sold stocks during the previous month had lower initial levels of subjective probability and a slightly larger decline. Overall, the relationship between trading and the levels of and changes in subjective probability were not as strong among respondents whose only stock holdings were within retirement accounts as among those whose stocks were held outside of retirement accounts.

We performed a logistic regression similar to that described above, where level 1 corresponded to individuals who sold only or sold more than they bought; level 2 corresponded to individuals who neither bought nor sold; and level 3 corresponded to those who bought only or bought more than they sold (Table 9). Whereas the coefficient on the level in the previous month was highly significant, the coefficient on the change since the previous month was barely significant ($p= 0.046$). Thus, the effects on buying were substantially smaller than those for respondents who owned stocks outside of retirement accounts (Table 7), confirming our expectations about greater passivity among stock owners in retirement accounts.

CONCLUSIONS

According to the leading theory of efficient markets and expectation formation, recent movements in stock prices should have no effect on expectations about future price changes. Yet we found that on average expectations depend on stock price changes with lags ranging from changes during the most recent week to changes more than a month ago. Furthermore, stock trading responds to changes in expectations even when the change in expectations was several weeks before the trade. These results

suggest that expectations and trading are related to stock price changes in an intertemporally complex manner.

As in other papers, we find that expectations about stock market gains are pessimistic, leading to the conclusion that the lack of stock holding does not need exotic explanations such as extremely high risk aversion or formidable barriers to entry. Rather, for many people, the stock market is dominated by savings accounts.

We conclude that we need a better understanding of expectation formation and how those expectations are translated into choice.

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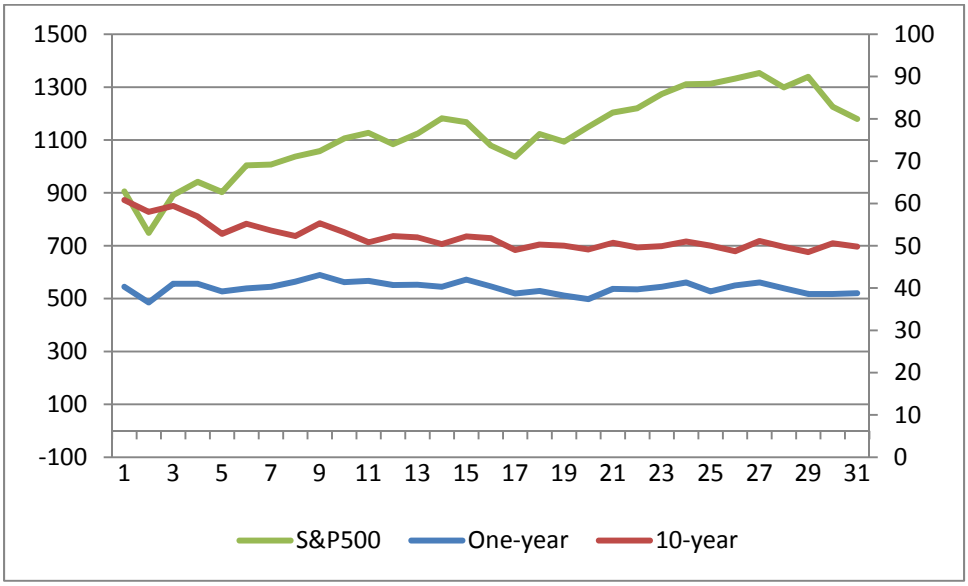
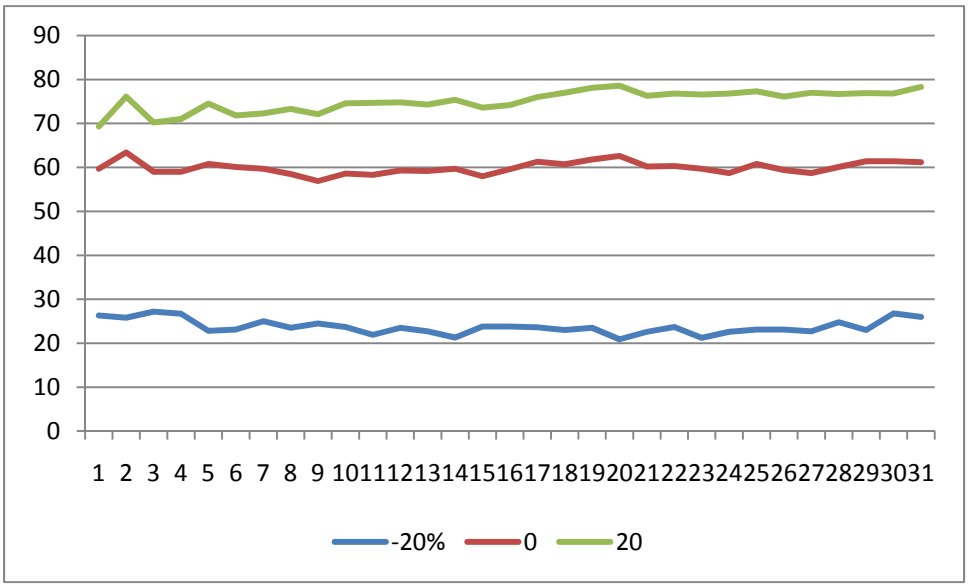
Figures and Tables

Figure 1. Closing prices of S&P 500, average subjective probability of one-year gain and average subjective probability of 10-year gain, November 2008 to September 2011



S&P left axis; subjective probability right axis

Figure 2. Three points on the cumulative distribution of the one-year rate of return, November 2008 to September 2011.



Note: The bottom line shows the probability that the rate of return will be less than -20 percent; the middle line shows the probability that the rate of return will be less than zero; and the top line shows the probability that the rate of return will be less than +20 percent.

Figure 3. One-month change in the subjective probability of a one-year gain (%) and of the S&P 500 (%)

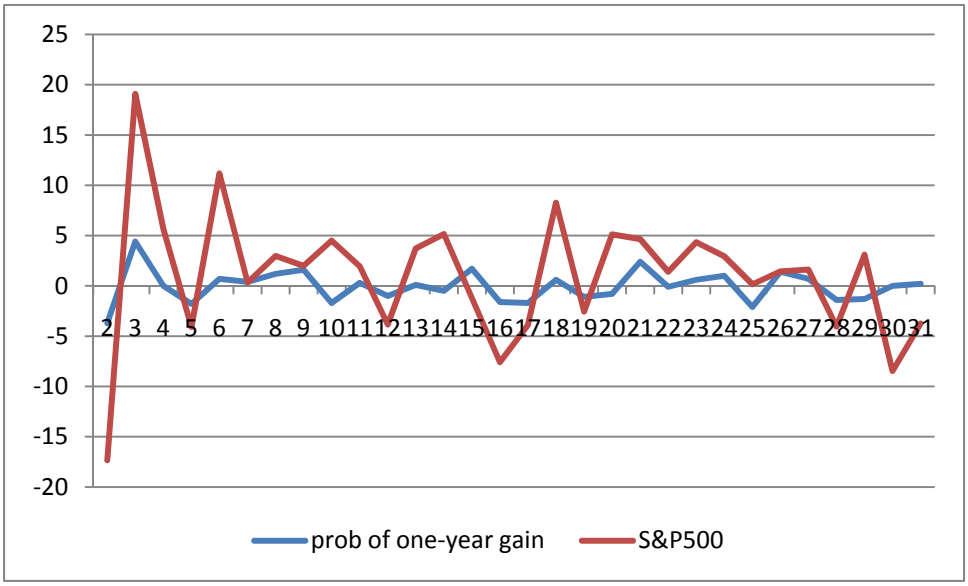


Figure 4. Change in the subjective probability of one-year gain (percentage points)

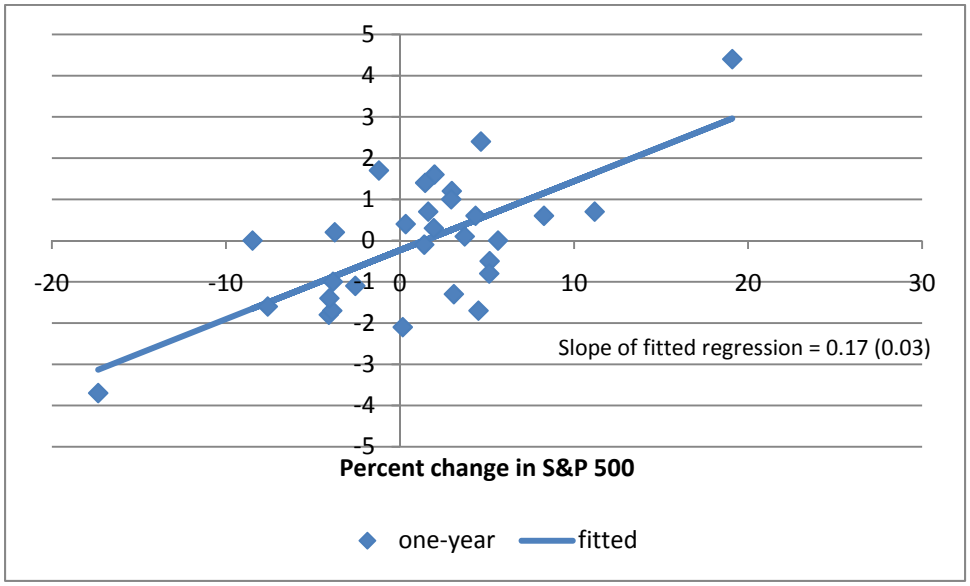


Figure 5. Closing price of the S&P 500 and the expected one-year rate of return

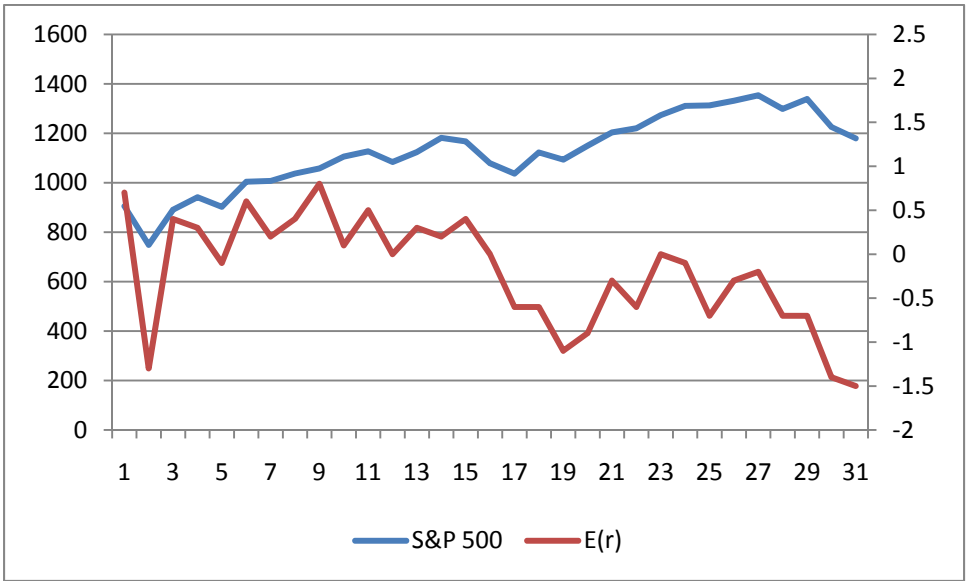


Figure 6. Change in the expected return (E(R)) in percent

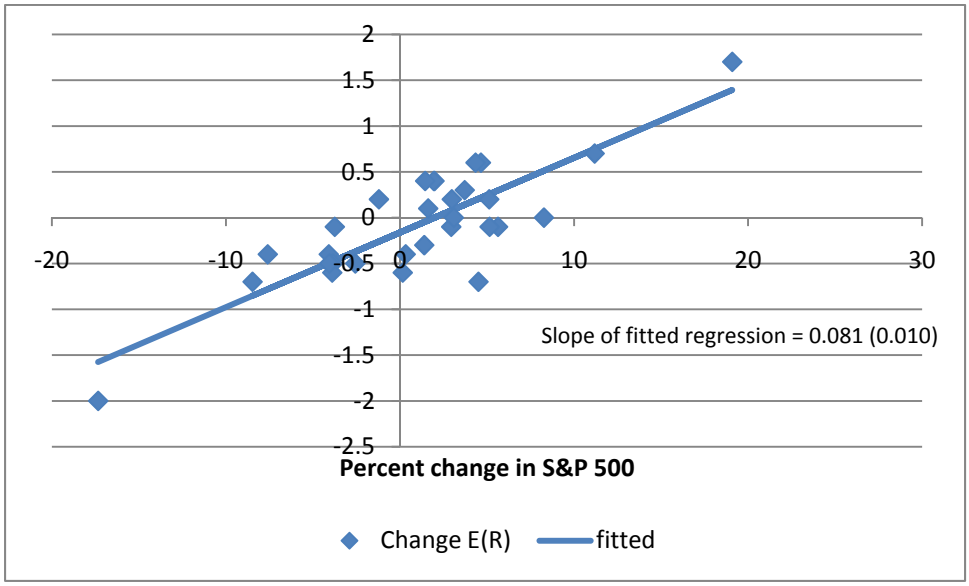


Table 1. Regression coefficients and standard errors from regression of one-month change in subjective probability of a one-year gain (in percent) on one-month percent change in S&P 500

	Stock holder		Follows stock market		Understands stock market		
	Yes	No	Yes	No	very well/ somewhat	a little	not at all
Coefficient	0.221	0.112	0.158	0.184	0.230	0.088	0.156
SE	0.041	0.060	0.044	0.042	0.045	0.058	0.049
Average probability	46.9	33.5	45.7	35.2	46.6	39.0	32.7

Table 2. Regression of one-month change in subjective probability of a one-year gain (in percent) on lagged changes in S&P 500 (in percent)

Lags in days	All	stock owner	not stock owner	follows market & good knowledge	does not follow and poor knowledge
1-7	0.143	0.163	0.109	0.261	0.054
8-14	0.190	0.207	0.166	0.179	0.127
15-21	0.272	0.277	0.262	0.331	0.209
22-28	0.206	0.243	0.146	0.311	0.181
29-35	-0.032	0.008	-0.088	0.046	-0.033
36-42	0.216	0.232	0.197	0.215	0.182
43-56	0.192	0.141	0.269	0.103	0.291
7-84	-0.021	-0.030	-0.009	-0.070	-0.017
constant	-0.382	-0.349	-0.425	-0.443	-0.445

Note: all coefficients significant at 5% level except those shaded.
Lags are percent change over indicated lagged time period in days. For example the 1-7 lag is the percent change in the closing price of the S&P 500 from seven days prior to the survey to the day before the survey.

Table 3. Regression of one-month change in expected one-year rate of return (in percent) on lagged changes in S&P 500 (in percent)

	All	stock owner	not stock owner	follows market & good knowledge	does not follow and poor knowledge
1-7	0.103	0.123	0.071	0.151	0.050
8-14	0.114	0.115	0.113	0.127	0.054
15-21	0.119	0.132	0.095	0.156	0.086
22-28	0.088	0.100	0.069	0.100	0.045
29-35	0.003	0.017	-0.018	0.037	-0.014
36-42	0.089	0.085	0.096	0.079	0.098
43-56	0.037	0.030	0.047	0.011	0.094

57-84	-0.014	-0.019	-0.006	-0.033	0.003
constant	-0.166	-0.198	-0.116	-0.203	-0.170

Note: all coefficients significant at 5% level except those shaded.
Lags are percent change over indicated lagged time period in days. For example the 1-7 lag is the percent change in the closing price of the S&P 500 from seven days prior to the survey to the day before the survey.

Table 4. Logistic regression of effects of monthly changes in the subjective probability of a one-year gain on the probability of quitting the stock market among owners

Subjective probability of one-year gain	Coefficient	Standard Error	Effect on Probability
Change t-1 to t	-0.990	0.239	-0.071
change t-2 to t-1	-1.691	0.297	-0.121
change t-3 to t-2	-2.125	0.295	-0.152
level t-3 (previous quarter)	-2.212	0.230	-0.159
constant	-1.384	0.108	--

Note: Quarterly observations on transitions from ownership to either ownership or not ownership. Average probability = 0.086. N = 7541. Standard errors adjusted for multiple observations on the same individual. Changes in the subjective probability of a gain are monthly changes: t measured in months

Table 5. Logistic regression of effects of monthly changes in the subjective probability of a one-year gain on the probability of entering the stock market among non-owners

Subjective probability of one-year gain	Coefficient	Standard error	Effect on probability
Change t-1 to t	0.770	0.279	0.074
change t-2 to t-1	1.345	0.332	0.129
change t-3 to t-2	0.944	0.305	0.091
level t-3 (previous quarter)	1.159	0.252	0.111
constant	-2.516	0.113	--

Note: Quarterly observations on transitions from not owning to either not owning or owning. Average probability = 0.111. N = 4694. Standard errors adjusted for multiple observations on the same individual. Changes in the subjective probability of a gain are monthly changes: t measured in months

Table 6. Level of and one-month change in the subjective probability of a one-year gain in the stock market according to trading in stocks held outside of retirement accounts during the previous month

Activity	Level	One-month change
Bought only	52.8	1.1
Sold only	48.4	0.1
Bought more than sold	57.0	2.0
Sold more than bought	53.2	-0.7
Neither bought nor sold	42.9	0.1

Note: Monthly observations. N = 49,106

Table 7. Logistic regression of trading in stocks owned outside of retirement accounts: coefficients and effects of changes in the subjective probability of a one-year gain on selling, buying or neither among those who owned in either of two adjacent waves

Subjective probability of one-year gain	Coefficient	Standard error	change in probability of selling	change in probability of neither selling nor buying	change in probability of buying
Change previous month to current month	0.479	0.118	-0.022	-0.035	0.057
Level previous month	0.645	0.186	-0.029	-0.048	0.077
Constant 1	-2.675	0.105			
Constant 2	2.144	0.112			
Population probability of selling, buying, or neither			*0.048*	*0.812*	*0.139*

Note: Monthly observations on trading. N = 16,845

Table 8. Level and one-month change in the subjective probability of a one-year gain in the stock market according to trading in stocks held in retirement accounts during the previous month

Activity	Level	One-month change
Bought only	53.7	-0.90
Sold only	45.7	-1.00
Bought more than sold	53.5	-0.50
Sold more than bought	47.7	0.10
Neither bought nor sold	46.8	0.00

Note: Monthly observations. N = 33,189

Table 9. Logistic regression of trading in stocks owned in retirement accounts: coefficients and effects of changes in the subjective probability of a one-year gain on selling, buying or neither among those who owned in either of two adjacent waves

Subjective probability of one-year gain	Coefficient	Standard error	Change in probability of selling	Change in probability of neither selling nor buying	Change in probability of buying
Change previous month to current month	0.275	0.138	-0.013	-0.003	0.016
Level previous month	0.803	0.165	-0.037	-0.009	0.046
Constant 1	-2.567	0.097			
Constant 2	3.125	0.103			
Population probability of selling, buying or neither			*0.050*	*0.888*	*0.062*

Note: Monthly observations on trading. N = 16603