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Abstract: Despite its importance for the analysis of life-cycle behavior and, in particular, retirement planning, stock ownership by private households is poorly understood. Among other approaches to investigate this puzzle, recent research has started to elicit private households' expectations of stock market returns. This paper reports findings from a study that collected data over a two-year period both on households' stock market expectations (subjective probabilities of gains or losses) and on whether they own stocks. We document substantial heterogeneity in financial market expectations. Expectations are correlated with stock ownership. Over the two years of our data, stock market prices increased, and expectations of future stock market price changes also increased, lending support to the view that expectations are influenced by recent stock gains or losses.

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1. Introduction

Despite its importance for the analysis of life-cycle behavior and, in particular, retirement planning, stock ownership by private households is poorly understood. For instance, according to standard economic theory and the historical record of stock market rates of return, almost all households should hold at least some common stocks, yet that is not the case. Explanations for the low level of participation typically center around high risk aversion and/or entry costs (Haliassos and Bertaut, 1995). But another type of explanation is that households have expectations of stock market returns that are more pessimistic than historical averages.

Among other approaches to investigate the stock holding puzzle, recent research has started to elicit private households' expectations of stock market returns (Dominitz and Manski, 2007).[1] Households' beliefs about future events play a central role in forward-looking models of decision-making. Examples of probability beliefs that may affect individual decisions abound (Hurd, 2009). They include beliefs about future labor market experiences, the future value of retirement portfolios of stocks, bonds, and social security benefits, and beliefs about receiving or leaving bequests, and health and mortality risks. Obtaining reliable measures of households' beliefs with respect to future events has been at the center of much research in survey design and analysis over the past decades. (See Manski, 2004, for an overview of the literature.)

There is now a broad consensus that data about households' beliefs should be obtained using probability formats rather than using discrete response alternatives and verbal descriptors such as "very likely", "likely", and "somewhat unlikely." The idea that probabilistic elicitation of expectations might improve on the traditional qualitative approaches of attitudinal research appears to have originated with Juster (1966). After some history in market research, probabilistic expectations questions have been used successfully in economic surveys since the early 1990s (Dominitz and Manski, 1997). In the United States, the Health and Retirement Study (HRS) has pioneered asking questions about subjective probability beliefs on a wide variety of topics, including general events (e.g., economic depression, stock market prices, weather); events with personal information (e.g., survival to a given age, entry into a nursing home), events with personal control (e.g., retirement, bequests). Recent research, reviewed by Manski (2004) and Hurd (2009), shows that responses to probabilistic expectations questions are predictive for

[1] See also Miniaci and Pastorello (2010) who discuss the importance of heterogeneous expectations for household portfolio diversification.

behavior. Vissing-Jorgenson (2003), for instance, documents that differences in opinion on future price developments among stockholders are related to the size of equity investments in their portfolio.

There are several explanations for heterogeneity in stock market expectations. It is not likely that differences in private information play an important role as they do in other domains like retirement planning and expected longevity where the personal health situation is an important predictor of the actual outcome. A more plausible explanation is that households differ in the way they access and process publicly available information (Hurd, 2009). The importance of differences in opinion for the operation of financial markets has been stressed frequently (Mayshar, 1983; Harris and Raviv, 1993; Jouini and Napp, 2007). The model by Kandel and Pearson (1995) explaining volumes of stock trading around public announcements of corporate earnings for instance is based upon well-educated research analysts using a differential interpretation of new information.

Dominitz and Manski (2009) suggest that there are at least three different models to form stock market expectations.[2] Individuals may base expectations upon the notion that stock market prices follow a random walk with drift; they may believe in mean reversion of stock prices; or they may believe in persistence of recent price changes. Moreover, individuals could use different models for different time horizons. The empirical evidence by Graham and Harvey (2001) documents heterogeneity in stock market expectations by CFOs of US firms, who should be experts because their expectations are important inputs in their corporate investment decisions. Their evidence suggests that on average persistence plays a role in the formation of one year ahead expectations but less so for longer term expectations.

This paper reports on findings from a study that repeatedly collected data on households' financial markets expectations (subjective probabilities of gains or losses). The data we analyze were obtained in April 2004 and in April 2006 in the CentER Panel, a representative internet survey of several thousand households in the Netherlands. Vis-à-vis the studies by Vissing-Jorgensen (2003) and Dominitz and Manski (2007, 2009), our analysis relies on a broader set of covariates. Compared to the papers by Hudomiet, Kézdi and Willis (2009) and Kézdi and Willis (2009), who analyze stock market expectations data collected in the covariate-rich HRS, our

[2] Branch (2004) provides an application in which consumers rationally choose different methods to form estimates of future price developments creating heterogeneity in inflation expectations. Carroll (2003) argues that expectations are updated probabilistically, fed by messages conveyed in newspapers and other media which may or may not come to the attention of the consumer which contributes to expectations heterogeneity.

sample spans the entire adult population. Our elicitation procedure differs from the approaches used in other studies: We asked each individual for probabilities at eight points in the outcome space, four in the gain domain (positive rates of return) and four in the loss domain (negative rates of return), providing data for a more reliable estimate of the mean and variance of individual subjective rates of return.[3]

Comparing stock market expectations at a two-year interval (2004 vs. 2006) is interesting because of the dynamics of the stock market experiences in this window. Figure 1 shows the Amsterdam Stock Market Index (AEX) for the period 1996–2010. The first interview was conducted about one year after the stock market had bottomed out following the dot-com crash of 2001. Experiences of large stock market losses should have been quite salient. In contrast, the 2006 interview was conducted three years into the recovery of the stock market (but well before the climax that preceded the financial crises of 2008).

To preview our results, the main findings can be summarized as follows. We find that individuals are much more pessimistic about rates of return in the Dutch stock market than would be estimated from historical stock performance: the average mean rate of return is barely positive and the variance is considerable. Individuals holding such subjective expectations are not likely to buy stocks. The distribution of subjective rates of return shifted to the right, i.e. respondents became more optimistic, between 2004 and 2006. Actual stock market performance was more consistently positive prior to 2006 than prior to 2004 which suggests, as has been found in U.S. data, that individuals focus on recent stock market performance when projecting rates of return. There was no change in the distribution of the variance in rates of return, making stocks a more attractive investment. In the Dutch population, the data from the CentER Panel we analyze in this paper suggest that overall the fraction of stock owners remained fairly constant in this period (about 12 to 13 percent in both years). There is considerable heterogeneity in expected rates of return. While some of the variation could be measurement error, some of it is systematic: for example, women have lower expected rates of return, and active traders have higher expected rates of return. In regressions, those with higher rates of return are more likely to own stocks, and those who perceive more risk in rates of return are less likely to own stocks. We conclude that at the population level the distribution of subjective rates of return in the stock market is adequate to

[3] Dominitz and Manski (2009) use a very similar approach but based upon four points of the subjective subjective probability distribution, which points differ between individuals as they depend on their estimate of the lowest and highest possible returns. Hudomiet, Kézdi and Willis (2009) estimate a different model (taking measurement error explicitly into account) using two points of the subjective probability distribution.

explain low levels of stock market participation and that it is not necessary to invoke very high levels of risk aversion.

In the remainder of this paper, we describe the design of the study (Section 2), characterize response behavior in the probabilistic expectations questions (Section 3), present descriptive statistics on the relationship between changes in stock ownership and changes in subjective probabilities (Section 4), and develop and estimate a simple model of individual stock market expectations (Section 5). We then present an analysis of how these individual-level parameters correlate with personal characteristics and stock market participation (Sections 6, and 7). Section 8 concludes.

2. Design and administration of the study

The study was conducted using the CentER Panel. The panel consists of some 2000 households in the Netherlands. The members of the panel are presented with questionnaires of varying length on every weekend; participation on each weekend is voluntary, but households generally participate in a large fraction of these interviews over the course of the year. In addition, all members of the CentER Panel participate in the DNB Household Survey (DHS), formerly known as the CentER Savings Survey. The DHS is a panel survey that started in 1993 and uses the CentER Panel as its sample. Data for this panel are collected every year in the spring. They contain information about employment, pensions, accommodation, mortgages, income, assets, debts, health, personal and household characteristics as well as economic and psychological concepts. Questions on subjective expectations for various events using probabilistic formats have been asked repeatedly in the CentER Panel, both as part of the DHS questionnaire and in other questionnaires. As a result, the members of the CentER Panel are well acquainted with this question format.

This paper draws on two components of a larger data collection. The larger study consists of several long "baseline" interviews and a sequence of short follow-up interviews. The first baseline interview was conducted in April 2004 as a supplement to the DHS 2004 questionnaire. It was repeated two years later, in April 2006. These interviews elicited information on stock-market expectations and trading behavior that was not already contained in the DHS instrument. In 2004, we also conducted short follow-up interviews with the respondents of the baseline interview. These follow-ups were conducted at a bi-weekly frequency over about six months,

from April through November. In this paper, we analyze data from the two cross-sections obtained in the April 2004 and April 2006 baseline interviews, not from the short follow-up interviews. We match these data with the very detailed data on variables such as education, employment history and marital status, exposure to risk in other domains as well as income, saving, and portfolio choice from the DHS panel.

The baseline questionnaires used in 2004 and 2006 collected background variables, including stock market experience, knowledge of average long-term returns for investment in risky and safe assets, and past trading history. Both questionnaires contained identical sequences of probabilistic expectations questions on stock market returns over a one-year horizon. [4] Specifically, we asked for the chances that an investment in a broad investment fund would generate gains of more than 0, 10, 20, and 30 percent as well as losses of more than 0, 10, 20, and 30 percent, for a total of eight questions. The four questions within each sequence (gains and losses) were always presented with increasing absolute threshold returns, but the gain and loss sequences were presented in random order (even though we did not find a significant order effect in a pre-test of our survey).[5] The sequence of gain and loss questions starts with a short introduction explaining that the respondent has to imagine that he unexpectedly received 10,000 Euro from a rich relative and is thinking of putting the money into a mutual fund invested in "blue chip" stocks (like those in the Amsterdam AEX stock market index). The wording of the first question in the gain sequence reads as follows:

Suppose you put the 10,000 Euro in the stock mutual fund and left it in for one year. What are the chances that you would make money where 0 means absolutely no chance and 100 means absolutely certain; that is what are the chances that in a year your investment would be worth more than 10,000 Euro?

The other questions in this sequence use a very similar wording with different numbers and adjusted to reflect the gain and loss sequence where appropriate. The precise wording and sequencing is available in the appendix (see also Figure 2).

3. Descriptive statistics

Table 1 reports the sample sizes achieved in the April 2004 and April 2006 interviews. The baseline interview was first presented to all panel members in week 17, as a supplement to the

[4] The complete 2004 and 2006 baseline questionnaires can be found at xxx (url).
[5] We have verified that also in the current survey the order of the gain and loss sequences did not make a difference for response patterns.

DHS 2004 questionnaire. The majority of panel members that were contacted in week 17 participated right away. Those who did not participate in week 17 were contacted again in week 21. The total number of baseline interviews conducted was 2170.[6] In 2006, the design was similar: Panel members were first approached in week 17, and those who did not participate right away were re-contacted in week 21. The total number of respondents in 2006 was 2121. About 70% of the 2004 respondents participated again in 2006.

The definitions of the covariates we use as predictors of stock market expectations in our subsequent analysis are reported in Table 2, along with descriptive statistics. The covariates in Table 2 include both socio-demographic information (gender, age, marital status, education and income) as well as the responses to questions on personal traits (trust, risk aversion and optimism) and behavior (moment of survey participation, recent asset trading, ownership of risky assets, following stock market) plus the perceptions of historical stock market performance. The sample composition in 2004 and 2006 is quite similar. There are slightly more men than women, three quarter of the respondents live together with a partner (including both married and unmarried couples) and about one in five respondents is older than 65. More than a third has attained a high level of education (i.e. completed higher vocational training or university). The majority of respondents has an optimistic view on life and is convinced that most people can be trusted. The vast majority of respondents are labeled risk averse meaning here that they choose their current income above a gamble with equal probabilities on a 33% worse lifetime income and a doubling of the income (i.e. the definition is based upon the first step in the sequence of questions as developed by Barsky et al (1997)). About a third of the respondents have risky assets (stocks, bonds or mutual funds) and a slightly higher fraction is following the stock market at least to some extent although most risky asset holders do not frequently buy or sell these assets. In both sample years a substantial amount of stockholders provides an estimate of historical annual stock returns above 12% or below 6%, while close to half of the respondents do not provide an estimate.

The average subjective probability of any gain was 41.6% in the 2004 data and 50.1% in the 2006 data. These averages reveal considerable pessimism compared with actual historical returns: in

[6] Respondents who participated in the second baseline interview differ in other aspects of their response behavior as well. Generally, they provide response of lower quality. This is a commonly observed phenomenon in the CentER Panel and other surveys: Early respondents are more highly motivated and provide "better" response, whereas late respondents are more reluctant.

67.8% of the one-year periods between January 1, 1983 and November 28, 2008 the change in the stock market was positive.[7]

Table 3 contains the distributions of the responses to the probabilistic stock market expectations questions. For example, when asked about the chances of a positive return, 84 respondents (3.9% of respondents) gave a zero chance that the stock market would be higher in a year. When asked about a stock market gain of more than 10%, 195 respondents (9.0%) gave that event a zero chance. Item nonresponse rates are considerably lower, 13% to 21%, than for our questions about historical rates of return in Table 2, which were almost 50%: individuals can express probabilities of future stock market gains and losses even though they have little, if any, knowledge of historical gains. At the population level, the overall pattern of responses conforms to expectations: the distributions of subjective probabilities are shifted towards lower probabilities for higher gains and for greater losses. In 2004, for example, 1025 respondents said that the probability of a positive gain was 0.50 or greater, which comprised about 54% of the valid responses. When the target gain was more than 30%, just 67 respondents said the probability was 0.50 or greater, which was 4% of the valid responses.

From other studies of probabilistic expectations, we know that the responses to such questions exhibit rounding to focal values such as 5%, 10%, 25%. In addition, there is commonly heaping in responses at the values of 0%, 50%, and 100%. We observe the same phenomena in our data. To illustrate, Figure 3 shows the response distribution to the question on a positive stock market return (i.e., the first question of the gain sequence) in the baseline interview of week 17 in 2004. Response distributions for other questions and weeks look qualitatively similar.

Heaping of responses at 50% is sometimes perceived as problematic since it may reflect phenomena other than just rounding – for instance, 50% responses could reflect "epistemic uncertainty," that is, they could disguise a "don't know" response (see Bruine de Bruin, *et al*., 2000, among others). A formal analysis of this behavior would require the specification of a mixture model that combines separate response processes for "continuous" observations (that may be subject to mild rounding) and for observations at the focal values of 0%, 50%, and 100%. Such a model would be beyond the scope of this paper, and we follow the majority of the literature in taking all responses as they are, without any correction for rounding and heaping (Manski, 2004; Manski and Molinari, 2010). However, we should note that in our data, the

[7] Calculated from averaging for each month between January 1, 1983 and November 28, 2008 the instances of gain over the succeeding year.

fraction of 50% responses is lower than in many other surveys. This is most likely due to the fact that CentER Panel members are experienced survey respondents.

4. Stock market expectations and transitions in ownership

Table 4 shows the average subjective probability of a stock market gain in the 2004 and 2006 cross-sections, the change in the cross-section probabilities, and, in the last column, the change in the average subjective probability in 2004 to 2006 panel data. The levels and changes are classified according to stock ownership in 2004 and 2006. For example, there were 1065 respondents who reported not owning stocks both in 2004 and in 2006, and their average subjective probability of a stock price gain was 41.7 in 2004. There were 990 respondents who reported not owning in 2004 and in 2006, and their average subjective probability of a gain was 49.3% in 2006.[8] Among the 920 persons who were observed in both waves and reported subjective probabilities in both, the (panel) changes were 7.6%, the same as the cross-section changes. Because the cross-section and panel changes are similar we will mostly discuss the cross-section levels and changes.

In the entire sample, the average probability of a stock gain increased by about eight percentage points. Those who were owners in both surveys were initially more optimistic than non-owners, supporting the hypothesis that greater subjective probabilities of a gain lead to greater ownership. Of note is that those who became owners between 2004 and 2006 were initially more optimistic than those who did not become owners, indicating that they were closer to the margin of purchase even in 2004. But even more direct confirmation of the hypothesis that expectations lead to purchases is the large increase in the subjective probability of a gain in that group: 14% in cross-section and 15% in panel. In a similar manner, those who transitioned from owning to not owning initially had rather pessimistic expectations, indicating they were closer to the margin of selling even in 2004. And their gain in optimism was the smallest (marginally) of any group.

These results are not statistically significant, but the overall patterns provide support for the hypothesis that subjective probabilities of stock market gains lead to stock purchases and sales. But these results would need to be verified by future research based on larger samples, and,

[8] The number of observations is reduced from the number in Table 3 because we impose the requirement that the subjective probability distributions of each respondent be weakly monotonic, a condition necessary for estimating individual-level parametric distributions. Furthermore, the number of observations in the "2004" column differs from that in the "2006" column because of differing rates of item nonresponse to the stock gain questions in the two waves.

particularly, on higher frequency of measurement. For example, an alternative explanation for the changes in Table 4 is that people buy or sell stocks in response to, say, an income shock, and then rationalize their actions by changing their subjective expectations.[9] We would need higher frequency data where we could test for the temporal sequence of expectations and actions.

5. A parametric model of stock market expectations

In this section, we develop a model that allows us to characterize respondents' stock market expectations at the individual level. Our goal is to obtain estimates of the mean and variance of the distribution of anticipated stock market returns for each individual. We make the simplifying assumption that stock market returns are normally distributed; this assumption is a simplification but not unreasonable as the distribution of AEX returns shown in Figure 4 suggests.[10]

Let s_t be the stock market price at time t. Suppose that s_t evolves according to

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

where α is the rate of drift in stock prices (which, according to Figure 4, would be about 12%) and the v_t are i.i.d. $N(0,\sigma^2)$. Thus stock prices follow a random walk with drift α per time period.

In that

$$\ln\left(\frac{s_{t+2}}{s_{t+1}}\right) + \ln\left(\frac{s_{t+1}}{s_t}\right) = \ln\left(\frac{s_{t+2}}{s_t}\right) = 2\alpha + v_t + v_{t+1},$$

we can write in general that

$$\ln\left(\frac{s_{t+\tau}}{s_t}\right) = \tau\alpha + \sum_{j=t}^{\tau-1} v_j$$

or

$$\ln s_{t+\tau} = \ln s_t + \tau\alpha + \sum_{j=t}^{\tau-1} v_j,$$

[9] The fact that buyers had initially high expectations and sellers had initially low expectations argues somewhat against this explanation.

[10] As a robustness check we also fitted nonparametric distributions that will be reported in the Appendix.

which implies that

$$\ln s_{t+\tau} \mid \ln s_t : N(\ln s_t + \tau\alpha, \tau\sigma^2).$$

Thus at time t the expected percent gain (or gain in logs) will have mean of $\alpha\tau$ and variance $\tau\sigma^2$ and the gain will be constant over time for the same projection period (τ). Under this model all information about projected levels is in the current level so that past levels or changes will not predict future levels. One advantage of this formulation is that the model can be fitted over any time period.

If people form their expectations according to this model, they will report somewhat higher probabilities of gains than of losses (assuming that α is positive), and the distribution of anticipated stock market gains is stationary. The model thus allows us to test for population stationarity by testing whether the reported average points on the distribution are constant. Note that if there is heterogeneity in beliefs (variation across people in α and in σ^2), the population distribution of anticipated gains will not be normal, but if each person forms beliefs according to the model the probability points will be stable.

We have asked about the probability that the stock market will gain x% or more over the next year which is the same as asking for the probability that

$$\frac{s_{t+\tau}}{s_t} > \delta.$$

δ takes the values 1.0, 1.1, 1.2, and 1.3 and τ is 12 if the unit of time measure is one month.

$$P\left(\frac{s_{t+\tau}}{s_t} > \delta_j\right) = P\left(\ln\frac{s_{t+\tau}}{s_t} > \ln\delta_j\right) = \Phi\left(\frac{\alpha\tau - \ln\delta_j}{\sqrt{\tau}\sigma}\right)$$

and j indexes the target probabilities.

We also asked about

$$P\left(\frac{s_{t+\tau}}{s_t} < \delta\right),$$

where $\delta = 1.0, 0.9, 0.8$ and 0.7. The probabilities of these events are

$$\Phi\left(\frac{\ln\delta_j - \alpha\tau}{\sqrt{\tau}\sigma}\right).$$

Thus we have eight observations on probabilities that depend on just two parameters α and σ. Note that an alternative formulation would be to treat the probabilities of gain differently from the probabilities of loss which would mean that we would estimate four parameters

$$\mu_g, \sigma_g, \mu_l \text{ and } \sigma_l,$$

where the subscripts indicate that the estimations are over gains only or over losses only.

Suppose that probability expectations are unbiased for the *ith* person, that is

$$p_{ji} = \Phi\left(\frac{\alpha\tau - \ln\delta_j}{\sqrt{\tau}\sigma}\right) + u_{ji}$$

and the u_{ji} have expectation of zero. Then the population will have rational expectations, i.e. the sample average of the p_{ij} will be equal to the average historical probability of a gain of δ or more over τ time periods. Furthermore, each individual will have the same probability expectations.

For the purposes of the present paper, we focus on the estimation of the parameters α and σ at the individual level. For each respondent, we use nonlinear least squares, obtaining those values of α and σ that minimize

$$\sum_j \left(p_{ji} - \Phi\left(\frac{\alpha\tau - \ln\delta_j}{\sqrt{\tau}\sigma}\right)\right)^2,$$

where j sums over eight target points.[11]

In order to obtain stable results, responses at the individual level have to satisfy some consistency requirements relating to the laws of probability. In particular, we exclude those respondents who (i) reported probabilities that are not (weakly) monotonically decreasing as the thresholds increase (in absolute terms) in the gain and loss domains or (ii) whose probabilities for a gain and loss sum to more than 100%.[12]

[11] In this paper we impose the same model parameters for gains and for losses.

[12] There are also respondents who report estimates for the probability of a loss and the probability of a gain sum up to a percentage less than 100. While being inconsistent with a continuous probability distribution, it suggests that these respondents use a rule of thumb discrete distribution with a non zero probability mass on the stock market providing a zero annual return.

6. Heterogeneity of individual stock market expectations

Figure 5 illustrates how the normal probability model is fit to data on four individuals, each of whom has reported eight points on their distributions of one-year stock market returns. In these examples the estimated alphas vary from 0.00 to 0.09 and the estimated sigmas vary between 0.02 and 0.06. We fit such models to all respondents in 2004 with valid sequences of subjective probabilities, and, separately, to all such respondents in 2006.

Table 5 provides the percentiles of the distributions of the estimated mean and standard deviation (volatility) of stock market returns among our respondents for the 2004 and 2006 surveys.[13] The subjective distribution of stock market returns shifts to the right, i.e. the 2006 respondents are more optimistic than the 2004 respondents, while the estimated volatility is quite comparable. The median α increases from 0.3% to 2.1%. The shift in expected returns is in line with recent investor experiences in the stock market (see Figure 1). Between 2000 and 2003 the AEX-index experienced a huge loss: from top to bottom the total drop is close to 70%. At the time of the 2004 baseline survey the stock market index had recovered part of this loss, but the recollection of a few bad investment years was most likely still quite vivid. In 2006 the stock market index had showed a steady increase for three years in a row. Nevertheless, the level of the index was still far below its peak levels, which might explain why most respondents were still quite modest in their expectations. Overall, except for a small increase in optimism the distributions for the expected return and the volatility of returns are quite stable. This conclusion is confirmed by Figures 6 and 7 which plot the empirical cumulative probability distribution of the mean and standard deviation, respectively, of expected stock market returns. The empirical distribution of the standard deviation is virtually identical in the 2004 and 2006 sample. The distribution of the mean of expected stock market returns makes a clear shift to the right.

Table 5 also shows that males and those who own risky assets are more optimistic than females and than respondents who have no risky assets in their portfolio. For example, in 2006 the median of the alphas was 0.008 for females vs. 0.029 for males, a difference of 2 percentage points. We also find differences in the cross-sectional distribution of alphas by covariates not reported in Table 5. The medians of the alphas among respondents with low and high education are 0.016 and 0.028, respectively, for 2006. Remarkably, the cross-sectional distributions of alpha do not

[13] The nonparametric distributions are similar; see Appendix 2. The importance of this similarity is that nonparametric estimation is less attractive when just a few points on the distribution of returns are elicited, and in that situation the assumption of normality can be made.

differ much between age groups in either year. As for the distributions of the sigma, the median among males is lower than among females, and the median among owners of risky assets is lower than in the population. Thus both the mean and the variance of expected returns suggest that males should hold stocks more frequently than females.

Tables 6 and 7 show how the individual-level estimates of expected stock market mean return and volatility, respectively, are related to personal characteristics and some subjective measures that aim to capture individual heterogeneity. A median regression of the mean of anticipated returns on personal characteristics confirms individual heterogeneity in stock market expectations, in particular for gender. The results indeed show that females are more pessimistic on stock market returns than males. Age and education matter very little once the personal and subjective measures are included. The only variation with respect to income is between the lowest income quartile and the other three. People who classify themselves as optimistic or as trusting have higher expected returns. Respondents who report lower estimates of annual historical returns (i.e. below 6% annually) are also more pessimistic about future annual stock market returns.

In explaining the variation in the volatility of the fitted stock market distribution, age is an important covariate in all specifications: young respondents perceive a higher level of uncertainty in future stock market developments. This might reflect the fact that young people have a relatively shorter period in which they might have observed stock markets, and yet they have witnessed a serious boom and bust. Although trust is significant in the 2006 data and optimism is significant in the 2004 data, no variables besides age are significant in both years.

7. Stock Market Expectations and Stock Market Participation

Table 8 shows the estimated marginal effects of personal and household characteristics on the probability of stock ownership. They are based on probit specifications estimated separately on the 2004 and 2006 data. Being female is associated with a reduction in the probability of ownership of 0.045 to 0.075 depending on the year and the specification. The patterns of ownership mostly conform to our priors: older and more educated people are more likely to own; ownership increases sharply in income. Most relevant for this paper is the strong association between ownership and the subjective probability of a stock market gain: after controlling for demographics and personal and household characteristics, an increase in the expected one-year gain of 0.10 (a one-year 10% gain) is associated with an increase in the ownership probability of

0.029 in the 2004 data and 0.049 in the 2006 data.[14] In that the stock ownership rate in the sample we study here was about 15% in both 2004 and 2006 these changes would increase the ownership rate by 20-30 percent.[15] Furthermore, in 2006 we find a signification negative relationship between the subjective standard deviation of stock returns and ownership: an increase in the subjective standard deviation of 0.10 is associated with a reduction of 0.04 in the probability of ownership.[16] These results accord with standard portfolio choice theory.

8. Conclusions

We found that on average the Dutch population holds rather pessimistic views about the stock market: the average subjective probability of an increase in stock values over a year was just 41.6% in 2004, and 50.1% in 2006. This pessimism, combined with a perceived (and actual) risk of holding stocks is sufficient to explain the low rates of stock holding in the population. It is not necessary to invoke very high rates of risk aversion to explain the stock holding puzzle.
The shift to more optimistic views between 2004 and 2006 suggests that recent stock market price movements have an important influence on expectations, as has been found in U.S. data. This greater optimism, combined with stability in expectations about the variance in stock price increases, should have made stocks a more attractive investment, leading to an increase in stock holdings. Indeed at the individual level we found suggestive evidence (but not statistically significant) that transitions into stock holding were associated with above-average increases in expectations of a gain and that transitions out of stock holding were associated with less optimistic changes in expectations, changes similar to those of people who were not stock owners in either wave. Nonetheless, the fraction of our sample holding stocks did not change between 2004 and 2006. We cannot estimate the net fraction that "should" have transited into stock holdings as we would need data on a large range of person characteristics such as risk aversion and on household characteristics such as wealth and pensions. But respondents perceive that stock market investments expose investors to very substantial risk. We estimate the median standard deviation of subjective one-year rates of return to be 0.10. Thus for the median person

[14] Such a change in alpha corresponds to change from the median to the 95th percentile in the 2004 distribution of expected rates of return (Table 5).
[15] The ownership rates at the bottom of Table 8 vary between specifications because stock owners are more likely to answer questions about stock market expectations and to give valid answers to subjective probability questions about stock market gains.
[16] A reduction in the standard deviation of 0.10 is approximately associated with a movement from the 25th percentile to the 75th percentile in the 2004 distribution of standard deviations (Table 5).

there is approximately a 0.15 chance of a gain of greater than 10% and a 0.15 chance for a loss of more than 10%.[17] An implication is that a larger shift in the expected return may be required to observe a shift in ownership rates. Indeed, according to our estimates in Table 8, an increase in the expected rate of return of 0.02, which is our estimate of the increase between 2004 and 2006, would increase the stock ownership rate by just 0.006 or 0.010 depending on whether we use the 2004 or 2006 probit results.

To make further progress in quantifying the relationship between expectations and stock trading, we need higher frequency data. We would like to observe the temporal relationships among actual stock price changes, changes in expectations, and stock purchases and sales. Nonetheless, in our view, these results show the promise of asking about subjective probabilities of stock price movements in household surveys, and of using those responses to understand stock holdings.

[17] Calculation based on our assumption of normal rates of return.

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Appendix: Nonparametric estimation of subjective return distributions

As a robustness check for the parametric fitting procedure of the means and variances of the subjective distributions of one-year stock-market returns, we describe in this Appendix a method for computing such estimates without making parametric assumptions. The basic idea is to average the historic stock market returns within each of the nine brackets defined by the eight return thresholds, using the respondent's reported probability as weights.

From the survey data, we construct probabilities $P(r \in I_j)$ for the eight brackets, $I_1 = (-\infty,-30\%)$, $I_2 = (-30\%,-20\%)$, …, $I_9 = (30\%,\infty)$, scaling such that these nine probabilities sum to 100%. Our nonparametric estimate of the expected rate of return is then given by

$$E(r) = \sum_j E(r \mid r \in I_j)\, P(r \in I_j) ,$$

where $E(r \mid r \in I_j) = R_j$, the historical average of one-year rates of return that are in interval j, calculated from the AEX stock market data shown in Figure 1 (but only up to 2004). A nonparametric estimate of the respondents' subjective standard deviation, $s(r)$, can be obtained by taking the square root of the variance given by $var(r) = E(r^2) - E(r)^2$, where

$$E(r^2) = \sum_j E(r^2 \mid r \in I_j)\, P(r \in I_j) .$$

This method could also be applied using the data from respondents who did not answer all eight questions, or whose reported probabilities violated the laws of probability because of non-monotonicity. Such respondents were dropped from the parametric analysis in this paper, and we thus also drop them from the nonparametric estimation to make results comparable.

Table A.1 compares the estimates of $E(r)$ and $s(r)$ obtained using this nonparametric method with the parametric estimates of alpha and sigma reported in the paper. These estimates are remarkably close in terms of the means, medians, minima and maxima of their cross-sectional distributions in both years, and they are also highly correlated at the individual level. These results support our reliance on the parametric estimates.

Table 1: Sample sizes in 2004 and 2006

2004		
Full sample	2170	100.0%
Interview in week 17	1834	85.5%
Interview in week 21	336	14.5%
2006		
Full sample	2121	100.0%
Interview in week 17	1691	79.7%
Interview in week 21	430	20.3%
Re-interviews of 2004 respondents	1510	71.2%
Refreshment sample	611	28.8%

Table 2: Definitions of and descriptive statistics for the explanatory variables

Variable label	Definition	2004		2006	
	0-1 dummies, taking the value 1 when the following applies to the respondent [a)]	**N**	**Mean**	**N**	**Mean**
Female	female	2170	0.466	2121	0.479
Partner in HH	married or living together with a partner	2170	0.773	2121	0.776
Female * partner in HH	female and either married or living together with a partner	2170	0.352	2121	0.360
Age: young	age 44 or younger	2170	0.398	2121	0.385
Age: old	age 65 or older	2170	0.177	2121	0.201
Education: low	completed no more than primary school or prevocational training	2170	0.321	2121	0.306
Education: high	completed higher vocational training or university education	2170	0.358	2121	0.364
HH income quartiles 1-4	monthly gross household income belongs to specific sample quartile	2170	0.250	2121	0.250
Trust	agrees with “most people can be trusted”	2027	0.514	1995	0.603
Risk averse (2004 only)	prefers current income above a 50-50 gamble with chances on doubling it or cutting it by a third	2038	0.872	1433	0.877
Optimistic (2004 only)	(strongly) agrees with “overall, I expect more good things to happen to me than bad things”	2170	0.557	1510	0.560
Late respondent	participated in the interview only at the second opportunity (week 21)	2170	0.155	2121	0.203
Traded assets in last 3 months	bought or sold bonds, mutual funds or stocks in the last three months	2170	0.092	2121	0.097
Follows the stock market	follows the stock market “somewhat” or ”very closely”	2170	0.414	2121	0.341
Estimate of hist. return < 6%	estimates average annual return AEX over last 20 years below 6%	1117	0.235	1233	0.304
Estimate of hist. return > 12%	estimates average annual return AEX over last 20 years above 12%	1117	0.243	1233	0.219

a) Observation is missing when a respondent answers “do not know”
Note: The precise wording of questions is provided in the appendix.

Table 3: Number of observations and distribution (%) of responses to the stock market expectations questions

Response interval	**return > 0%**		**return > 10%**		**return > 20%**		**return > 30%**		**return < 0%**		**return < 10%**		**return < 20%**		**return < 30%**	
2004	***N***	**distn**	***N***	**distn**	***N***	**distn**	***N***	**distn**	***N***	**distn**	***N***	**distn**	***N***	**distn**	***N***	**distn**
0%	*84*	3.9	*195*	9.0	*377*	17.4	*696*	32.1	*87*	4.0	*152*	7.0	*280*	12.9	*475*	21.9
1%-49%	*778*	35.9	*1312*	60.5	*1330*	61.3	*1066*	49.1	*978*	45.1	*1236*	57.0	*1282*	59.1	*1131*	52.1
50%	*423*	19.5	*175*	8.1	*55*	2.5	*33*	1.5	*467*	21.5	*192*	8.9	*81*	3.7	*73*	3.4
51%-99%	*577*	26.6	*161*	7.4	*69*	3.2	*32*	1.5	*316*	14.6	*226*	10.4	*150*	6.9	*103*	4.8
100%	*25*	1.2	*7*	0.3	*3*	0.1	*2*	0.1	*38*	1.8	*22*	1.0	*15*	0.7	*17*	0.8
Don't know	*283*	13.0	*320*	14.8	*336*	15.5	*341*	15.7	*284*	13.1	*342*	15.8	*362*	16.7	*371*	17.1
All	*2170*	100.1	*2170*	100.1	*2170*	100.0	*2170*	100.0	*2170*	100.1	*2170*	100.1	*2170*	100.0	*2170*	100.1
2006																
0%	*40*	1.9	*108*	5.1	*254*	12.0	*509*	24.0	*88*	4.1	*158*	7.4	*299*	14.1	*508*	24.0
1%-49%	*541*	25.5	*1203*	56.7	*1298*	61.2	*1116*	52.6	*1081*	51.0	*1256*	59.2	*1212*	57.1	*1022*	48.2
50%	*423*	19.9	*181*	8.5	*77*	3.6	*39*	1.8	*413*	19.5	*135*	6.4	*67*	3.2	*59*	2.8
51%-99%	*727*	34.3	*218*	10.3	*74*	3.5	*33*	1.6	*170*	8.0	*138*	6.5	*102*	4.8	*76*	3.6
100%	*39*	1.8	*8*	0.4	*2*	0.1	*1*	0.0	*16*	0.8	*11*	0.5	*7*	0.3	*9*	0.4
Don't know	*351*	16.5	*403*	19.0	*416*	19.6	*423*	19.9	*353*	16.6	*423*	19.9	*434*	20.5	*447*	21.1
All	*2121*	99.9	*2121*	100.0	*2121*	100.0	*2121*	99.9	*2121*	100.0	*2121*	99.9	*2121*	100.0	*2121*	100.1

Note: Columns contain distributions of responses to the various one-year rates of return.

Table 4: Average probability of stock market gain by transition in ownership between 2004 and 2006

		cross-section			
		2004	2006	change	panel change
Not owning to not owning	%	41.7	49.3	7.6	7.6
	N	1065	990		920
Not owning to owning	%	45.2	59.4	14.2	15.1
	N	49	47		47
Owning to not owning	%	41.8	49.2	7.4	9.4
	N	52	51		49
Owning to owning	%	50.8	59.8	9.0	8.2
	N	153	151		148
All	%	42.9	50.9	8.1	8.0
	N	1319	1239		1164

Table 5: Descriptive statistics for the fitted subjective probability distribution of the stock market rate of return

	alpha		sigma	
percentile	2004	2006	2004	2006
	All respondents			
5	-0.169	-0.100	0.033	0.037
25	-0.021	-0.003	0.062	0.062
median	0.003	0.021	0.105	0.098
75	0.037	0.058	0.176	0.169
95	0.105	0.157	0.373	0.378
N	1251	1273	1251	1273
	Females			
5	-0.216	-0.136	0.034	0.036
25	-0.032	-0.011	0.064	0.062
median	-0.001	0.008	0.111	0.108
75	0.031	0.048	0.197	0.194
95	0.093	0.168	0.385	0.392
N	507	537	507	537
	Males			
5	-0.159	-0.07	0.030	0.037
25	-0.015	-0.001	0.061	0.061
median	0.010	0.029	0.101	0.093
75	0.042	0.061	0.162	0.151
95	0.114	0.152	0.344	0.341
N	744	736	744	736
	Owns risky assets			
5	-0.155	-0.066	0.030	0.034
25	-0.010	-0.001	0.061	0.061
median	0.012	0.031	0.097	0.093
75	0.044	0.061	0.160	0.150
95	0.112	0.155	0.329	0.315
N	629	603	629	603
	Does not own risky assets			
5	-0.192	-0.116	0.034	0.038
25	-0.034	-0.007	0.066	0.062
median	0	0.012	0.115	0.103
75	0.032	0.056	0.190	0.185
95	0.098	0.158	0.395	0.388
N	762	820	762	820

Table 6: Median regressions of the mean (alpha) of the fitted subjective probability distribution of the stock market return

	2004	**2004**	**2006**	**2006**
Female	-0.001	-0.002	-0.015*	-0.012
	[0.006]	[0.006]	[0.008]	[0.010]
Partner in HH	0.003	0.000	0.002	0.002
	[0.005]	[0.005]	[0.006]	[0.007]
Female * partner in HH	-0.011*	-0.008	-0.003	-0.002
	[0.007]	[0.007]	[0.009]	[0.011]
Age: young	0.001	-0.002	0.003	0.001
	[0.003]	[0.003]	[0.005]	[0.005]
Age: old	-0.006	-0.004	-0.002	-0.002
	[0.004]	[0.004]	[0.005]	[0.006]
Education: low	0.004	-0.001	0.005	0.009
	[0.004]	[0.004]	[0.005]	[0.006]
Education: high	0.003	-0.001	0.004	0.004
	[0.003]	[0.003]	[0.005]	[0.005]
HH income: 2nd quartile	0.014***	0.015***	0.014**	0.014*
	[0.005]	[0.005]	[0.006]	[0.007]
HH income: 3rd quartile	0.015***	0.010**	0.011*	0.014*
	[0.005]	[0.005]	[0.006]	[0.007]
HH income: 4th quartile	0.014***	0.011**	0.013**	0.007
	[0.005]	[0.005]	[0.006]	[0.007]
Trust	0.007**	0.008***	0.011***	0.011**
	[0.003]	[0.003]	[0.004]	[0.005]
Risk averse	-0.009**	-0.011***	0.004	0.002
	[0.004]	[0.004]	[0.006]	[0.006]
Optimistic	0.007**	0.011***	0.015***	0.011**
	[0.003]	[0.003]	[0.004]	[0.004]
Late respondent	-0.004	-0.005	-0.007	0.004
	[0.004]	[0.004]	[0.005]	[0.006]
Traded assets in last 3 months		0.011**		0.008
		[0.004]		[0.006]
Follows the stock market		0.003		-0.001
		[0.003]		[0.005]
Estimate of hist. return < 6%		-0.011***		-0.014***
		[0.004]		[0.005]
Estimate of hist. return > 12%		0.003		-0.011*
		[0.004]		[0.006]
Constant	-0.007	-0.002	0.004	0.007
	[0.007]	[0.009]	[0.007]	[0.011]
Number of observations	1175	783	895	680

Note: Standard errors in brackets; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 7: Median regressions of the standard deviation (sigma) of the fitted subjective probability distribution of the stock market return

	2004	**2004**	**2006**	**2006**
Female	-0.001	-0.000	0.010	0.003
	[0.013]	[0.013]	[0.010]	[0.010]
Partner in HH	-0.005	-0.005	0.003	-0.008
	[0.010]	[0.010]	[0.008]	[0.007]
Female * partner in HH	0.005	0.004	-0.012	-0.004
	[0.015]	[0.015]	[0.011]	[0.012]
Age: young	0.030***	0.025***	0.041***	0.034***
	[0.007]	[0.007]	[0.005]	[0.005]
Age: old	-0.017*	-0.011	-0.009	-0.002
	[0.009]	[0.009]	[0.006]	[0.006]
Education: low	-0.008	-0.024***	-0.001	-0.003
	[0.008]	[0.009]	[0.006]	[0.006]
Education: high	-0.005	-0.009	-0.007	-0.000
	[0.007]	[0.007]	[0.005]	[0.005]
HH income: 2nd quartile	-0.015	0.005	-0.008	0.003
	[0.010]	[0.010]	[0.007]	[0.007]
HH income: 3rd quartile	-0.037***	-0.021**	-0.009	-0.012
	[0.010]	[0.010]	[0.007]	[0.008]
HH income: 4th quartile	-0.019*	-0.005	-0.013*	-0.008
	[0.011]	[0.011]	[0.007]	[0.008]
Trust	-0.005	-0.005	-0.014***	-0.016***
	[0.006]	[0.006]	[0.005]	[0.005]
Risk averse	0.000	-0.003	-0.002	0.002
	[0.009]	[0.008]	[0.006]	[0.006]
Optimistic	-0.018***	-0.028***	-0.003	-0.007
	[0.006]	[0.006]	[0.005]	[0.005]
Late respondent	0.010	0.010	0.012**	0.011*
	[0.009]	[0.009]	[0.006]	[0.006]
Traded assets in last 3 months		0.013		0.002
		[0.009]		[0.006]
Follows the stock market		-0.015**		-0.001
		[0.007]		[0.005]
Estimate of hist. return < 6%		-0.003		-0.012**
		[0.008]		[0.005]
Estimate of hist. return > 12%		0.010		0.012**
		[0.008]		[0.006]
Constant	0.136***	0.143***	0.101***	0.105***
	[0.014]	[0.015]	[0.011]	[0.011]
Number of observations	1175	783	895	680

Note: Standard errors in brackets; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 8: Probit regression for stock ownership

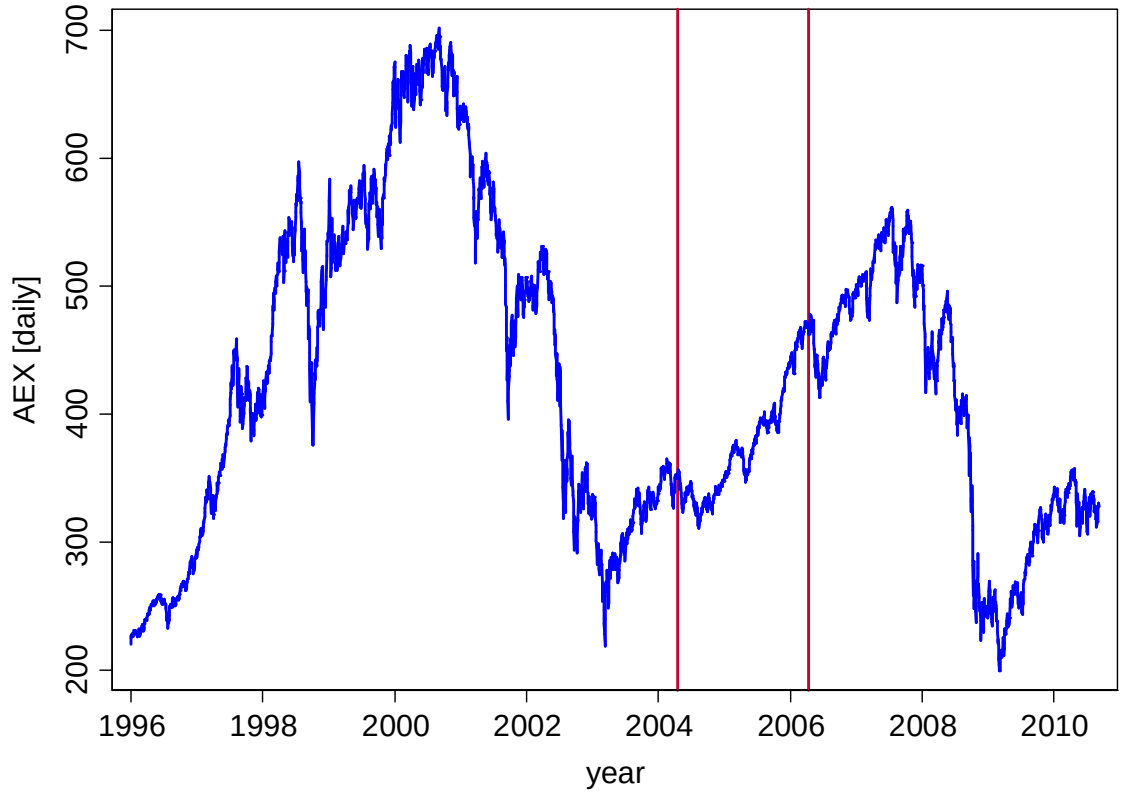
	2004	**2004**	**2006**	**2006**
Female	-0.069**	-0.075*	-0.064*	-0.045
	[0.032]	[0.042]	[0.039]	[0.056]
Partner in HH	-0.036	-0.063*	-0.050	-0.040
	[0.027]	[0.038]	[0.034]	[0.046]
Female * partner in HH	-0.012	-0.014	0.012	-0.004
	[0.037]	[0.051]	[0.047]	[0.065]
Age: young	-0.018	-0.036	-0.067***	-0.050*
	[0.018]	[0.025]	[0.019]	[0.029]
Age: old	0.060**	0.098***	0.050**	0.024
	[0.024]	[0.035]	[0.025]	[0.032]
Education: low	-0.032*	-0.031	-0.037	-0.004
	[0.019]	[0.029]	[0.023]	[0.034]
Education: high	0.005	0.005	0.012	-0.003
	[0.019]	[0.026]	[0.023]	[0.030]
HH income: 2nd quartile	0.047*	0.055	0.044	0.054
	[0.027]	[0.040]	[0.034]	[0.048]
HH income: 3rd quartile	0.037	0.018	0.069*	0.073
	[0.028]	[0.040]	[0.037]	[0.050]
HH income: 4th quartile	0.161***	0.176***	0.200***	0.245***
	[0.035]	[0.047]	[0.044]	[0.056]
Trust	-0.004	-0.020	0.002	-0.020
	[0.016]	[0.023]	[0.019]	[0.028]
Risk averse	-0.029	-0.009	-0.067**	0.022
	[0.024]	[0.031]	[0.032]	[0.035]
Optimistic	0.008	-0.009	0.012	-0.080*
	[0.016]	[0.023]	[0.019]	[0.042]
Late respondent	0.011	0.023	0.013	-0.003
	[0.022]	[0.034]	[0.025]	[0.026]
Mean (alpha) of the		0.291**		0.490**
fitted subjective probability distribution		[0.123]		[0.193]
Standard deviation (sigma) of the		0.121		-0.397**
fitted subjective probability distribution		[0.100]		[0.164]
Number of observations	1939	1175	1351	895
Mean of dependent variable	14.5%	17.6%	14.5%	17.7%

Notes: Coefficients expressed as marginal effects.
Standard errors in brackets; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A.1: Parametric and nonparametric estimates of subjective return distributions

	2004				2006			
	E(*r*)	alpha	s(*r*)	sigma	E(*r*)	alpha	s(*r*)	sigma
Mean	-0.002	-0.004	0.160	0.140	0.031	0.025	0.160	0.138
Median	0.006	0.003	0.153	0.105	0.029	0.021	0.152	0.098
Min	-0.406	-0.480	0.023	0.006	-0.364	-0.472	0.023	0.006
Max	0.308	0.439	0.384	0.978	0.370	0.481	0.399	0.941
Corr	0.871		0.890		0.773		0.801	
N	1251				1273			

Figure 1: Amsterdam Stock Market Index (AEX), 1996–2010



Note: The vertical lines show the timing of the 2004 and 2006 interviews (week 17).

Figure 2: Sequences of probability questions about stock price changes

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What are the chances that in a year a €10.000 investment in a mutual fund invested in "blue chip" stocks would be worth more or less than €10,000 where 0 means absolutely no chance and 100 means absolutely certain?

Chance > €10.000 ➔ Chance > €11.000 ➔ Chance > €12.000 ➔ Chance > €13.000 ➔ Chance < €10.000 ➔ Chance < €9.000 ➔ Chance < €8.000 ➔ Chance < €7.000

OR

Chance < €10.000 ➔ Chance < €9.000 ➔ Chance < €8.000 ➔ Chance < €7.000 ➔ Chance > €10.000 ➔ Chance > €11.000 ➔ Chance > €12.000 ➔ Chance > €13.000

Note: respondents are randomly assigned to one of these two sequences.

Figure 3: Distribution of responses to the question on the probability of a stock market gain (2004, week 17)

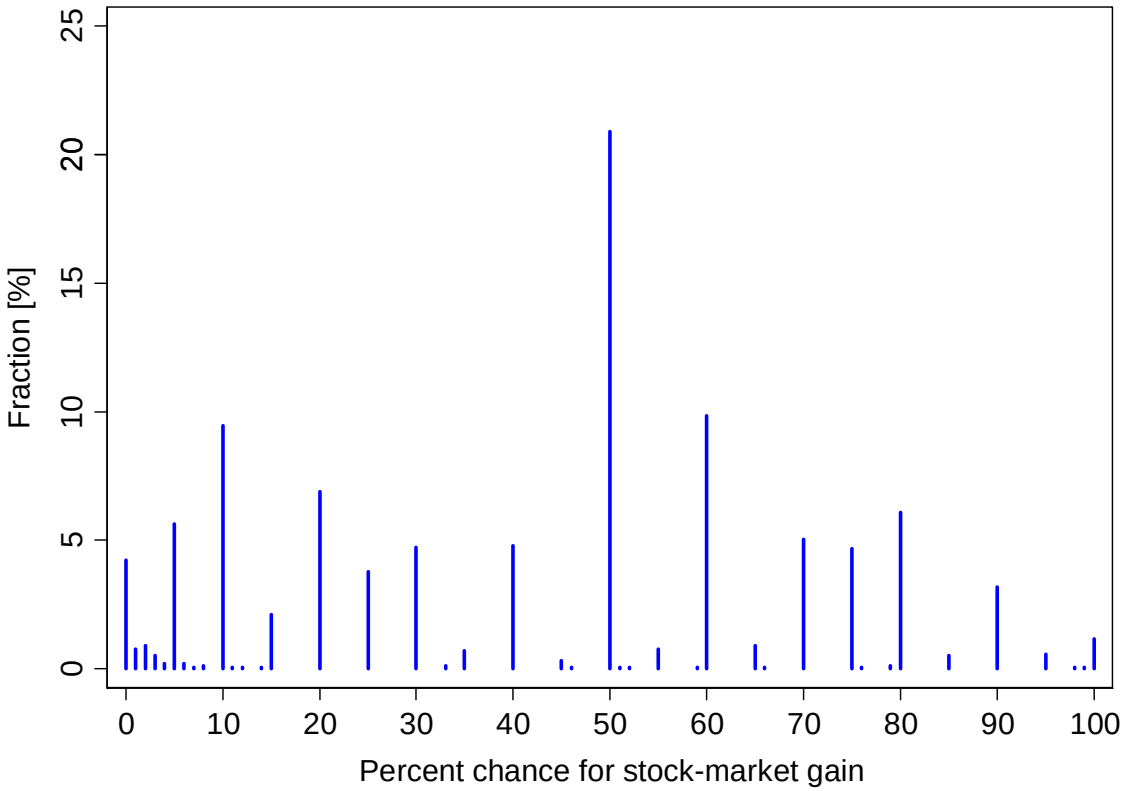
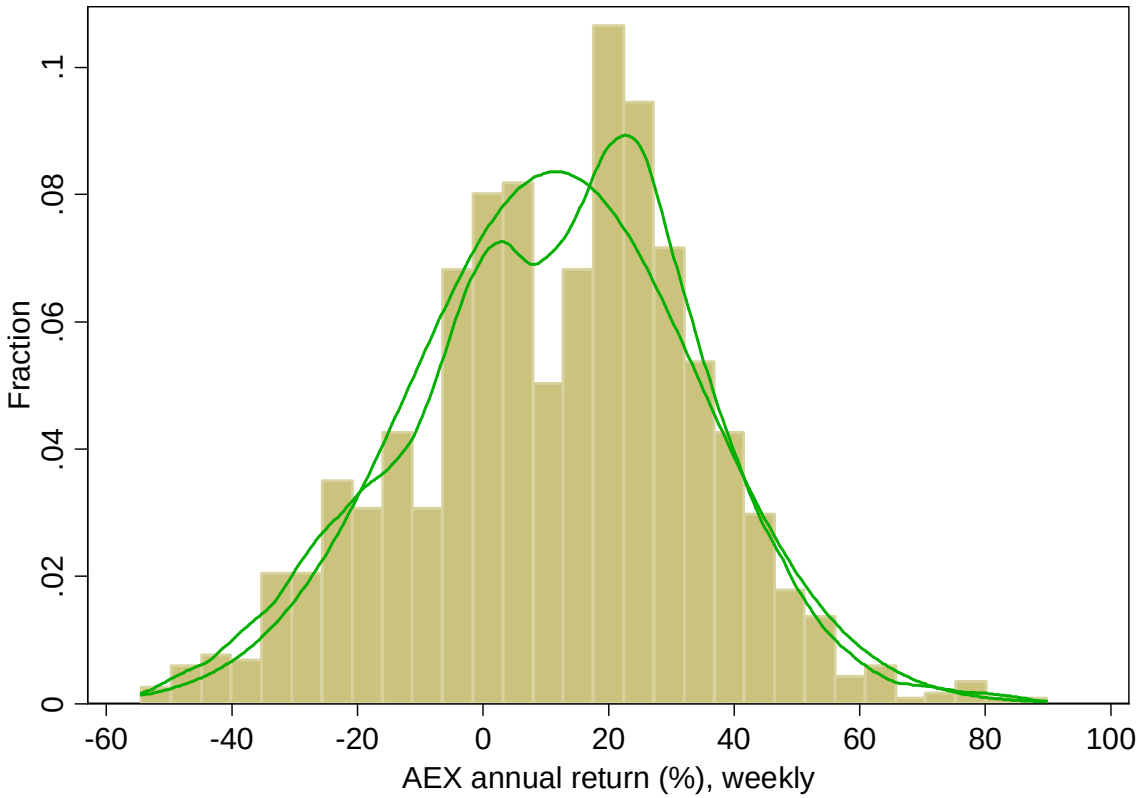


Figure 4: Distribution of annual returns to the Amsterdam Stock Market Index (AEX), 1983–2006



Note: These annual rates of return have been computed weekly based on the end-of-week index. The number of weeks is 1173, the mean annual return is 11.6% and the median annual return is 14.0%. The green lines are a kernel density estimate of the empirical density function and a fitted normal distribution, respectively.

Figure 5: Fitted expected distributions of stock market returns for four example respondents

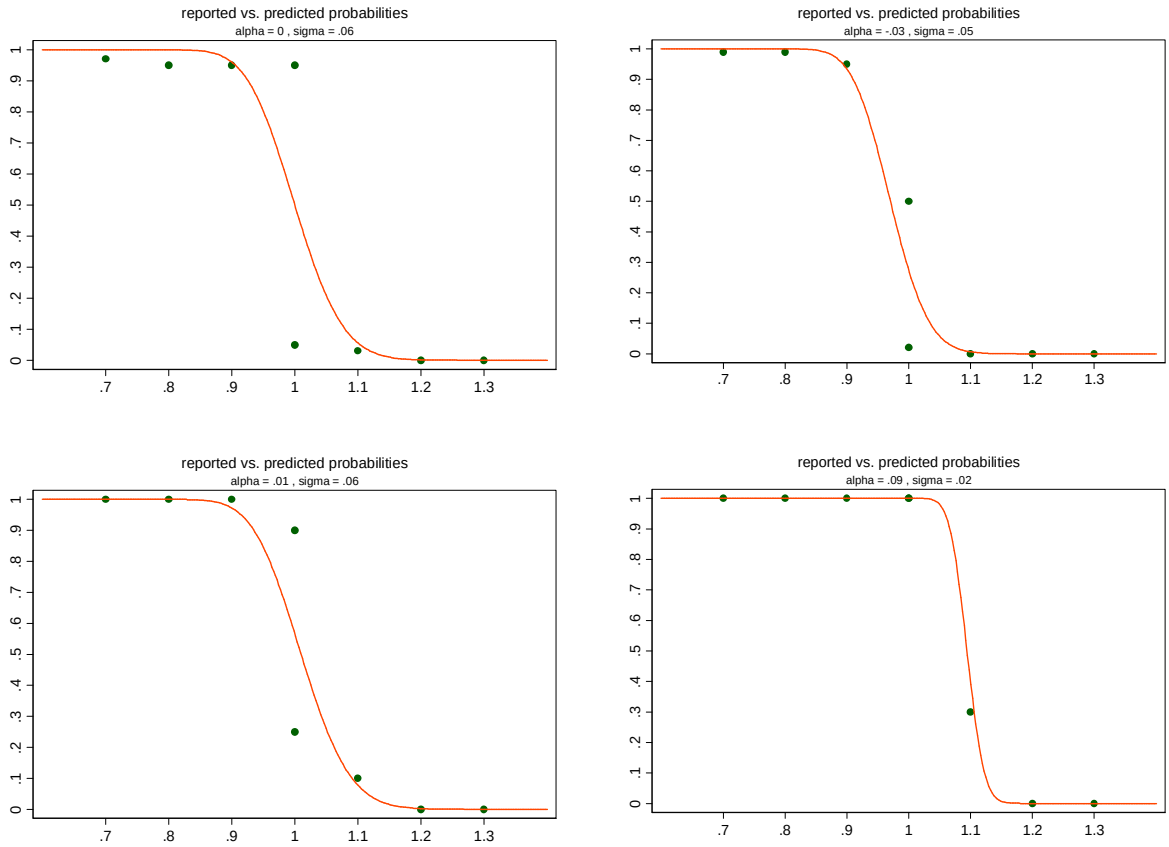


Figure 6: Empirical CDF of the mean of expected stock market returns (2004 vs. 2006)

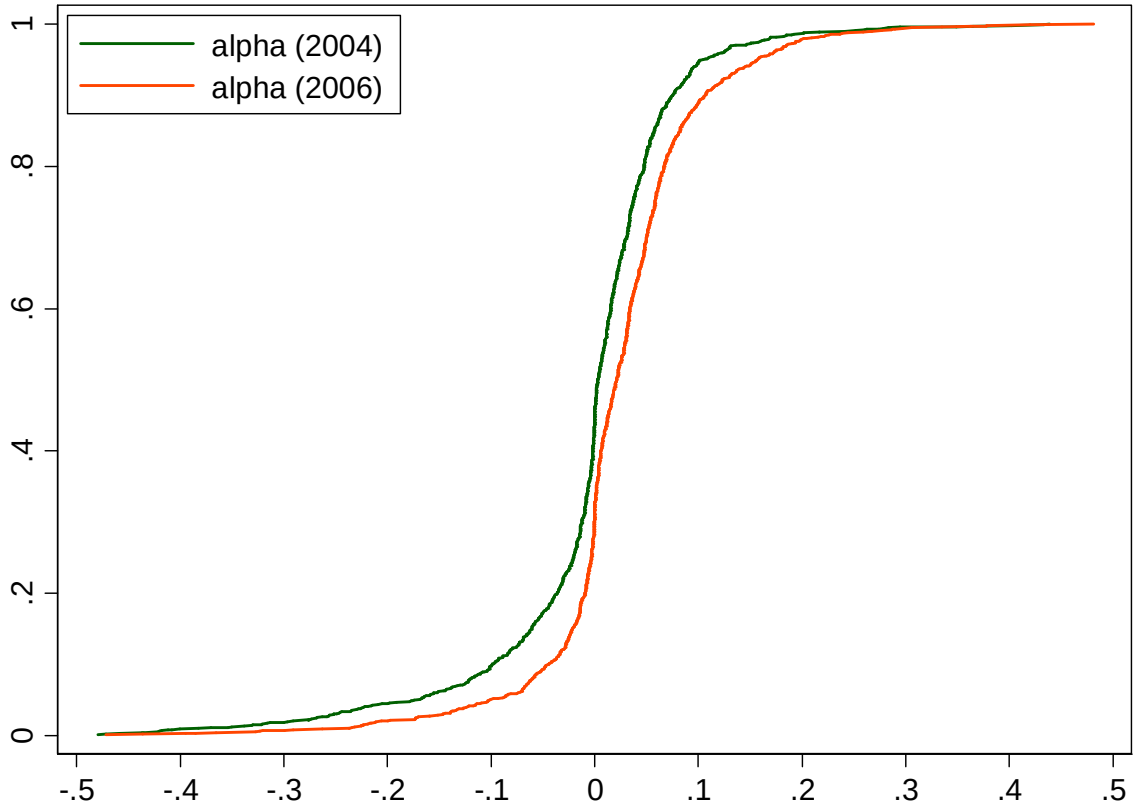
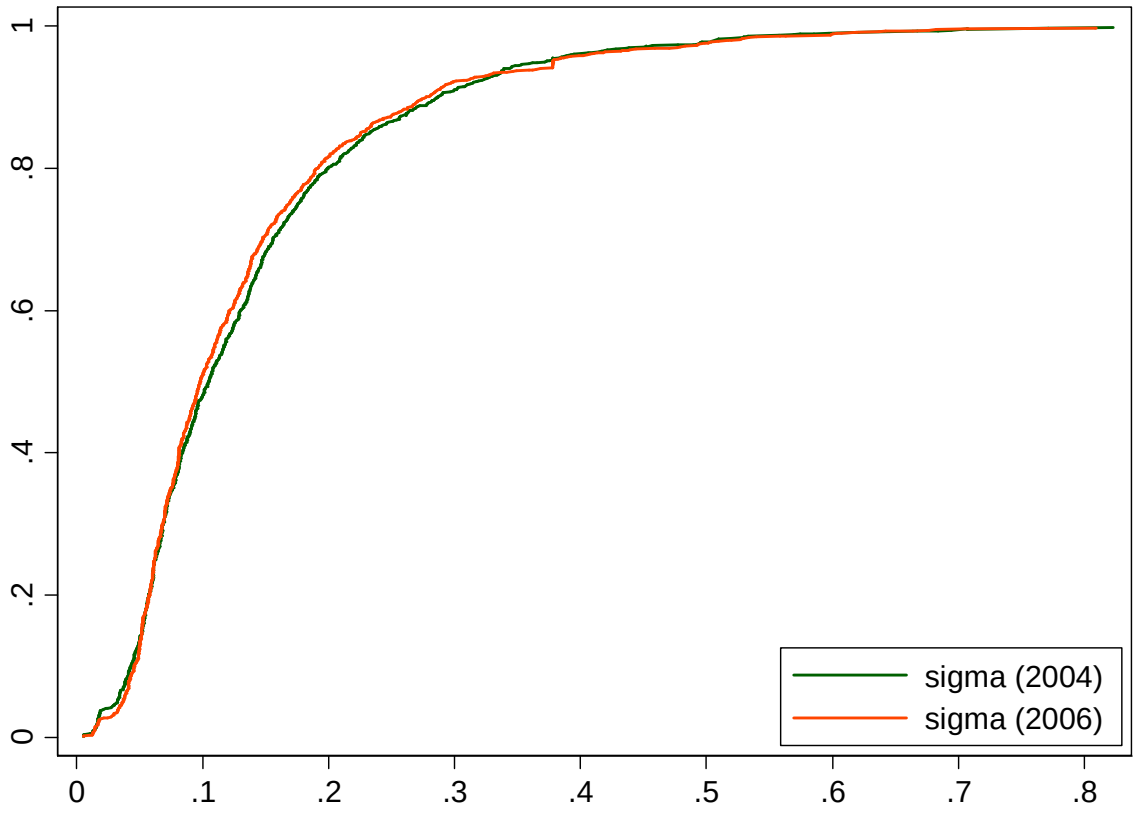


Figure 7: Empirical CDF of the standard deviation of expected stock market returns (2004 vs. 2006)



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