"Five Facts About Beliefs and Portfolios" Online Appendix

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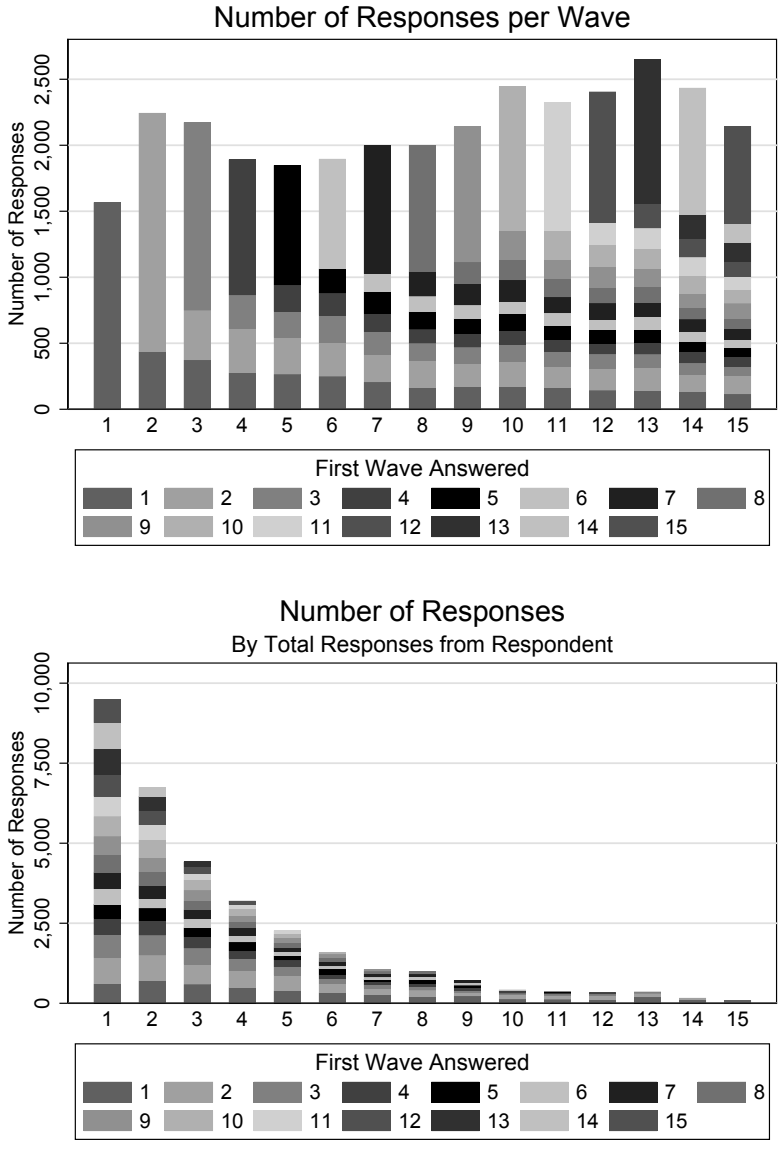
A.1 Response Rates to the GMSU-Vanguard Survey

In this Appendix, we further explore the response rates to the GMSU-Vanguard Survey. The top panel of Figure A.1 reports the number of responses in each wave, with different colors tracking the first wave in which an individual responded. Starting in wave 5, we receive more responses from individuals who are re-respondents than from individuals who are responding for the first time. The bottom panel shows that fewer than 30% of responses come from individuals who have responded to one survey only (and some of these may end up responding to future surveys). Over 35% of responses come from individuals who have responded to at least four survey waves, and more than 18% come from individuals who have responded to at least six survey waves.

Figure A.1: Number of Responses by Wave



Note: Figure shows number of responses to the GMSU-Vanguard Survey. The top panel shows the number of responses per wave. The bottom panel shows the total number of responses separately by how many survey waves a person has responded to. In both panels, the colors correspond to the waves in which these individuals first answered.

A.2 Flow-Performance Relationship in the Vanguard Data

The mutual fund literature has established that funds generally experience inflows after a positive return and that these inflows persist for a few months after the high returns. In this Appendix, we document that similar patterns exist for the sample of Vanguard funds and among the sample of Vanguard investors.

We take the work of Coval and Stafford (2007) as the benchmark for our analysis. In particular, Coval and Stafford (2007) regress each fund's current inflows (measured as a percentage of beginning-of-period total net assets) on twelve monthly lags of the funds' past returns and twelve monthly lags of flows into the funds. For convenience, we report the estimates from Column 4 of Table 1 in Coval and Stafford (2007) in column 3 of Table A.1 below. In the interest of readability, we do not report the coefficients on the 12 monthly lags of inflows, and focus on the coefficients on past returns, which are at the heart of the flow-performance relationship. As is clear from the table, Coval and Stafford (2007) found that lagged returns indeed positively affect current inflows, with the strongest effects for the returns in the most recent months. This is the standard flow-performance result referenced in the literature, which also includes Sirri and Tufano (1998) and Del Guercio and Tkac (2002).

Columns 1 and 2 of Table A.1 report estimates using the same regression specification as in Coval and Stafford (2007), but focusing only on Vanguard data. We follow Coval and Stafford (2007) in imposing thresholds on funds' assets under management (AUM) and the size of AUM changes for inclusion in the regression. These restrictions avoid giving weight in the results to large flows into funds very early in their operation. Specifically, we only use funds after they reach the minimum threshold of $10m assets under management.[1]

In column 1 of Table A.1, we explore aggregate flows into the universe of Vanguard mutual funds. The coefficients are very similar to those from Coval and Stafford (2007) reported in column 4, in particular for the first few lags of returns that are of the most central interest in the flow-performance literature. In column 2, we perform the analysis using only the flows into Vanguard funds coming from our survey respondents. Here we only include funds that are well represented in our sample. In particular, we focus on funds where our respondents collectively hold at least 0.04% of the total assets under management. This restriction ensures that our estimate of the flow-performance relationship is not dominated by noise for those funds that are held by only a small fraction of our respondents. Overall, these restrictions mean that the sample used to produce the results in column 2 includes 75% of the funds that were included in column 1 (and an even larger share of the AUM). Again, the coefficients are very close to those in the existing literature.

These results highlight that investors in Vanguard funds exhibit the same quantitative and qualitative flow-performance pattern documented in the previous literature for mutual funds more generally. We also find that the specific sample of investors that respond to our survey behaves similar in this respect to the broader population of investors.

[1] We also impose additional filters. In particular, we drop observations in which the total fund flows are more than 200% or less than -50% in a month, or in which the reported fund return differs by more than 20 percentage points from the return implied by combining fund flows and AUMs. These filters mostly exclude a few months at the very beginning of the life of a fund.

Table A.1: Fund Flows and Past Performance

	Current Fund Flows (% TNA)		
	(1) Aggregate	(2) Individual	(3) Coval/Stafford
L1.Returns (%)	0.086***	0.070***	0.074
	(0.008)	(0.015)	{23.88}
L2.Returns (%)	0.040***	0.086***	0.037
	(0.009)	(0.015)	{12.13}
L3.Returns (%)	0.017*	0.029	0.033
	(0.009)	(0.015)	{11.04}
L4.Returns (%)	-0.003	0.035*	0.024
	(0.008)	(0.015)	{7.99}
L5.Returns (%)	0.022**	0.040**	0.015
	(0.008)	(0.014)	{4.98}
L6.Returns (%)	0.001	0.028*	0.013
	(0.008)	(0.014)	{4.38}
L7.Returns (%)	0.004	-0.004	0.006
	(0.008)	(0.014)	{2.01}
L8.Returns (%)	-0.014	-0.047**	0.004
	(0.008)	(0.014)	{1.24}
L9.Returns (%)	-0.024**	-0.005	0.003
	(0.008)	(0.015)	{0.99}
L10.Returns (%)	-0.020*	0.016	0.007
	(0.008)	(0.015)	{2.48}
L11.Returns (%)	-0.026**	-0.005	0.000
	(0.008)	(0.015)	{0.13}
L12.Returns (%)	-0.006	0.032*	-0.009
	(0.008)	(0.015)	-{3.02}
Control for 12 Lags of Fund Flows	Y	Y	Y
R-Squared	0.183	0.035	0.367
N	19,957	14,633	50,181

Note: This table reports results from regressions of mutual fund flows on lagged fund flows and lagged fund returns. Mutual fund flows are measured as a percentage of beginning-of-period total net assets (TNA). In column 1, mutual fund flows are reported directly by each Vanguard fund, and exclude valuation movements of existing assets. In columns 2 and 3, mutual fund flows are estimated as the percentage change in TNA over the month, controlling for capital gains and losses of the initial holdings: $[TNA_t - TNA_{t-1} \times (1 + R_{t-1})]/TNA_{t-1}$. The pooled regression results are based on OLS coefficients, where the mean of each variable has been subtracted. In columns 1 and 2, we report standard errors and significance levels: * (p<0.10), ** (p<0.05), *** (p<0.01). In column 3, we follow Coval and Stafford (2007) original paper and report *t*-statistics.

A.3 Time-Series Dynamics: A Comparison With Other Surveys

In this Appendix, we compare the time-series variation of average beliefs in the GMSU-Vanguard survey with similar measures in other surveys. Since those surveys often cover longer time spans, this analysis helps verify that the time-series variation in beliefs over our sample period is similar in magnitude to the variation in other periods. In addition, by comparing patterns of beliefs across different surveys over the same time period, we can explore the extent to which the various surveys capture similar belief movements, despite differences in their samples and survey designs.

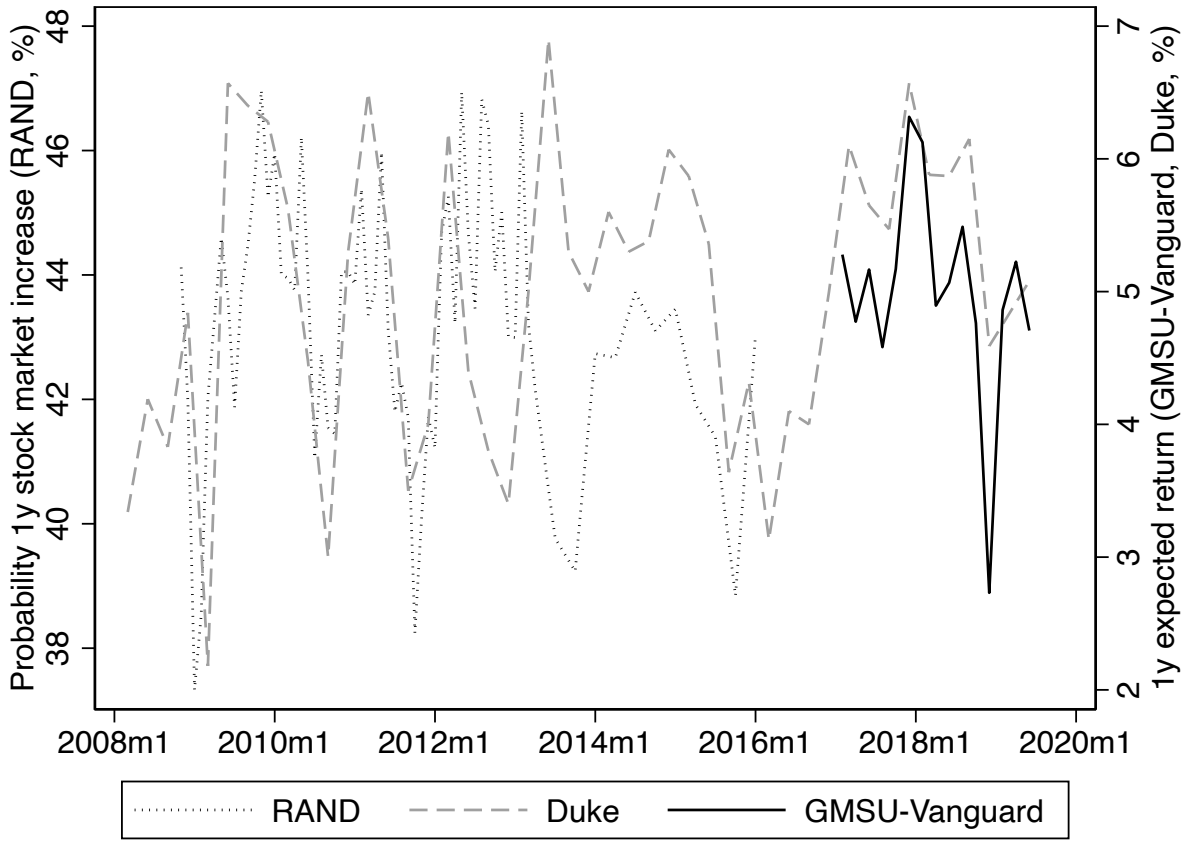
Specifically, for each wave we average our survey responses across individuals, focusing on the question about expected 1-year stock returns. We then compare the time-series dynamics of this average expected return to similar ones from four existing surveys: Robert Shiller's investor survey, the Duke (Graham-Harvey) CFO survey, the American Association of Individual Investors survey (AAII), and the RAND American Life Panel Survey (Financial Crisis). The Duke CFO survey asks explicitly about expected 1-year stock returns and is therefore directly comparable with our survey. All other surveys ask questions that are related to expected returns, but cannot be directly mapped to them. In those cases, we use the survey questions that are most closely related to 1-year expected stock returns. For the Shiller survey, we use the share of the respondents that report expecting an increase in stock market valuations over the next year; for the RAND survey, we calculate the average (across respondents) probability of a stock market increase over the next year; and for the AAII survey, we compute the difference between the percentage of bullish and bearish investors. Figure A.2 plots the time series of the GMSU-Vanguard survey together with the other surveys. For readability, we separate the plots into different panels that focus on comparisons between the GMSU-Vanguard survey and at most two other surveys (Panel A: Duke CFO and RAND; Panel B: Shiller; Panel C: AAII).

Since the beginning of our survey in February 2017, the average belief about 1-year expected stock returns has experienced significant variation. It started at just above 5% in the first survey wave, and reached above 6% by the end of 2017 (around the time President Trump signed the Tax Cuts and Jobs Act), only to fall back to around 5% shortly thereafter. We also observe a sharp drop and recovery in the last quarter of 2018, a pattern that mirrors the contemporaneous dynamics of the S&P 500 index over that same period. These patterns are broadly shared across the other surveys. First, quantitatively, Panel A of Figure A.2 shows that both the level and the variation of average beliefs during our sample period is quite similar to the one displayed by the Duke CFO survey (the RAND survey ended before the start of our sample). Second, from a qualitative perspective, the peak in optimism our survey displays at the end of 2017 is shared by most other surveys, despite differences in elicitation methods and target samples. Similarly, all surveys experience a drop in positive sentiment around the last quarter of 2018. Figure A.2 highlights that the variability across other surveys since 2017 is roughly similar to the variation in beliefs in these surveys since 2013, though it is naturally lower than during the Great Recession.

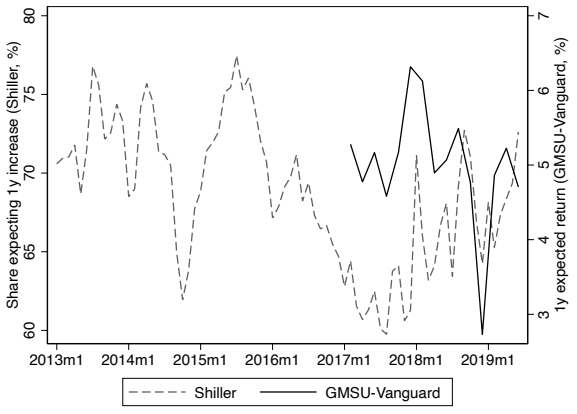
Taken together, these results highlight that despite differences in the investors that are surveyed and in the survey design and methodology, the main time-series features of the GMSU-Vanguard survey align both quantitatively and qualitatively with those of existing surveys.

Figure A.2: Comparison With Other Surveys

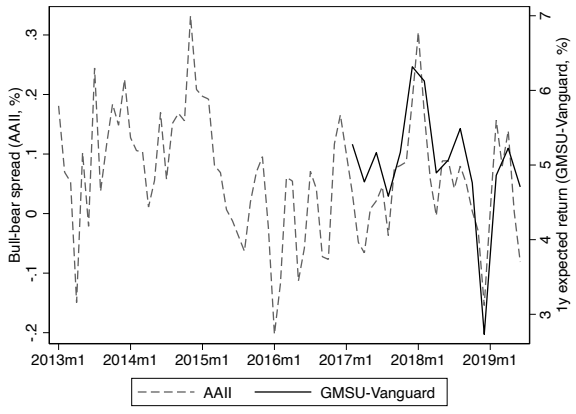
(A) GMSU-Vanguard vs. Duke CFO and RAND



(B) GMSU-Vanguard vs. Shiller



(C) GMSU-Vanguard vs. AAII



Note: The figure compares average beliefs about the 1-year stock market return in the GMSU-Vanguard survey with questions from other surveys. Panel A reports the average 1-year expected stock returns from the Duke CFO survey, and the average probability of a 1-year stock market increase from the RAND survey. Panel B reports the share of investors expecting an increase in market values in one year, from Shiller's investor survey. Panel C shows the bull-bear spread from the AAII survey.

A.4 Additional Summary Statistics

In this Appendix, we present additional summary statistics on the sample of respondents and the survey responses. We first describe the correlation across a number of investor characteristics. We then explore the full distribution of survey responses, as well as their within-response correlations.

Respondent Characteristics. Table A.2 explores average characteristics across various percentiles of the age and wealth distributions. Specifically, in columns 1, 2 and 3 we show summary statistics for individuals whose age is within one year of the 25th, 50th and 75th percentiles of the sample age distribution, respectively. In columns 4, 5, and 6, we show summary statistics for individuals who are within $10k of the 25th, 50th, and 75th percentiles of the sample wealth distribution, respectively.

Table A.2: Survey Respondent Summary Statistics

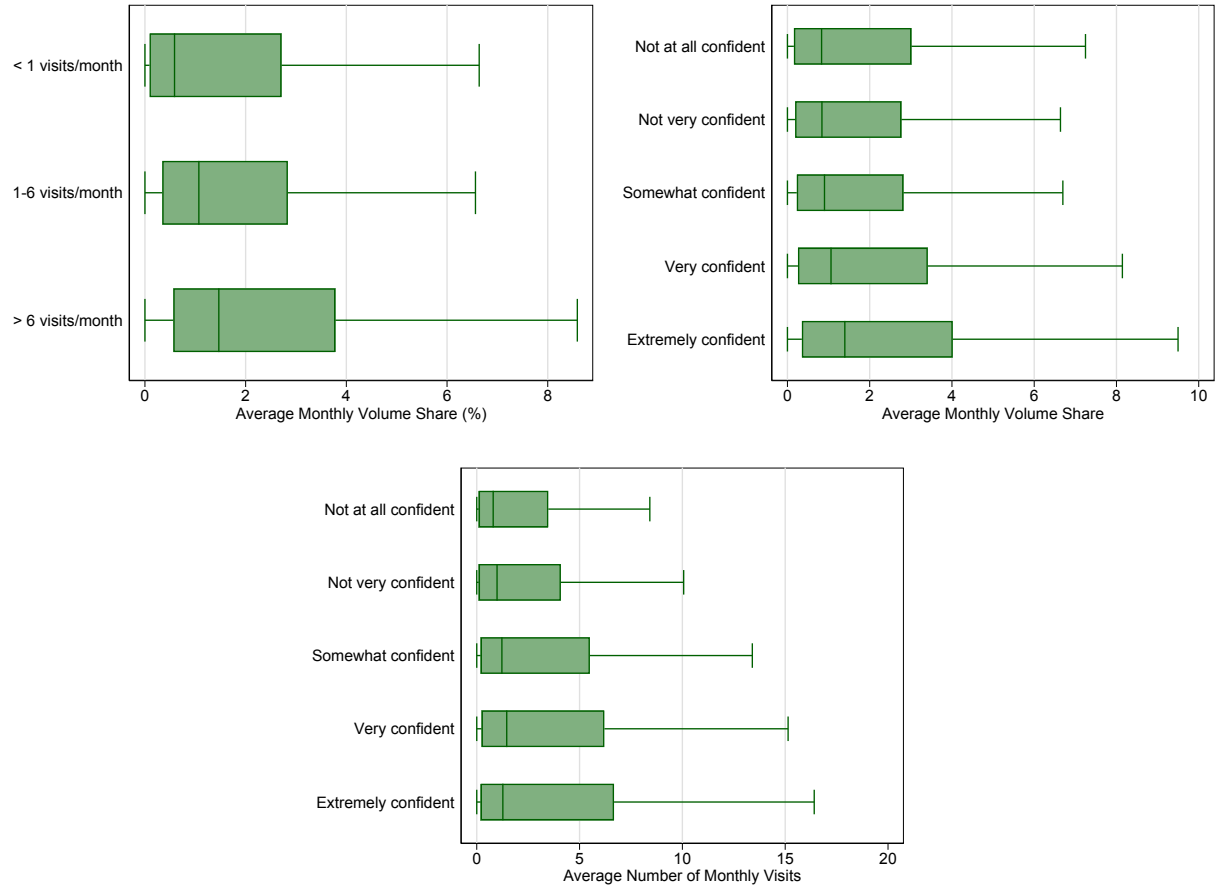
	Split by Age			Split by total Vanguard Wealth		
	P25	P50	P75	P25	P50	P75
Age (years)	51.0	62.0	70.0	54.6	58.4	64.7
Male	0.67	0.70	0.69	0.65	0.68	0.71
Region						
Northeast	0.23	0.24	0.21	0.21	0.27	0.25
Midwest	0.20	0.24	0.20	0.22	0.18	0.18
South	0.30	0.29	0.34	0.32	0.30	0.33
West	0.26	0.24	0.25	0.25	0.25	0.25
Total Vanguard Wealth (k$)	422.28	544.80	630.77	74.31	225.10	604.20
Length of Vanguard Relationship (Years)	14.10	16.20	17.60	12.49	15.42	17.40
Active Trades / Month	1.72	1.35	1.25	0.98	1.31	2.58
Monthly Portfolio Turnover (%)	2.40	2.27	1.82	1.97	2.23	2.84
Days with Log-Ins / Month	2.86	3.03	3.16	2.38	2.98	4.37
Total Time Spent / Month (Minutes)	22.00	23.89	26.80	12.38	20.58	49.67
Portfolio Shares (%)						
Equity	74.7	65.4	59.2	72.8	68.0	61.3
Fixed Income	14.4	22.2	26.2	17.5	19.2	23.0
Cash	8.4	9.8	12.3	8.0	9.5	11.0
Other/Unknown	2.5	2.6	2.3	1.8	3.3	4.7
Number of Unique Assets	7.31	7.26	7.68	3.67	5.80	9.81
Number of Mutual Funds	4.94	5.10	5.17	2.88	4.36	6.79
Number of ETFs	0.81	0.63	0.63	0.41	0.66	0.86
Number of Stocks	1.41	1.42	1.64	0.37	0.76	1.88
Number of Bonds	0.15	0.11	0.24	0.01	0.01	0.27

Note: Table shows summary statistics on our survey respondents, similar to Table I. Columns 1, 2, and 3 show summary statistics for individuals whose age is within one year of the 25th, 50th, and 75th percentile of the sample age distribution. Columns 4, 5, and 6 show summary statistics for individuals who are within $10k of the 25th, 50th, and 75th percentiles of the sample wealth distribution.

Table A.2 highlights a number of interesting correlations across different demographic characteristics of our respondents. Age and wealth are strongly positively correlated. Older people pay more attention to their portfolios, but they trade less frequently. Richer clients pay more attention and are more likely to trade. Older and richer clients both hold less equity and more fixed income assets and cash. While wealthier respondents are more likely to be male, we find no strong patterns in the gender composition of respondents by age.

In Section II of the paper, we show heterogeneities in the sensitivity of portfolio allocations to beliefs along a number of observable investor characteristics: investor trading volume (measured as the average monthly turnover as a share of portfolio value), investor attention (measured as the average number of days per month on which investors log into the Vanguard website), and investor confidence (expressed as the confidence in their beliefs about stock returns). Figure A.3 shows that these characteristics are relatively uncorrelated across individuals, and, as a result, that the various splits of the investor sample do capture distinct characteristics.

Figure A.3: Trading Volume, Attention, and Confidence

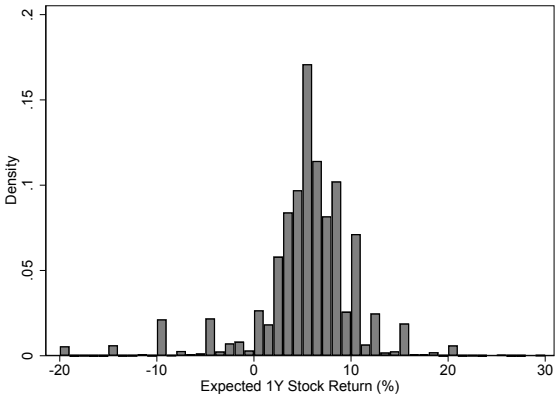


Note: Figure shows the distributions of the average monthly volume share by log ins (top left panel), the average monthly volume share by confidence (top right panel) and the average number of monthly Vanguard log-ins by confidence (bottom panel). The box plots show the 5th, 25th, 50th, 75th and 95th percentiles of the distribution.

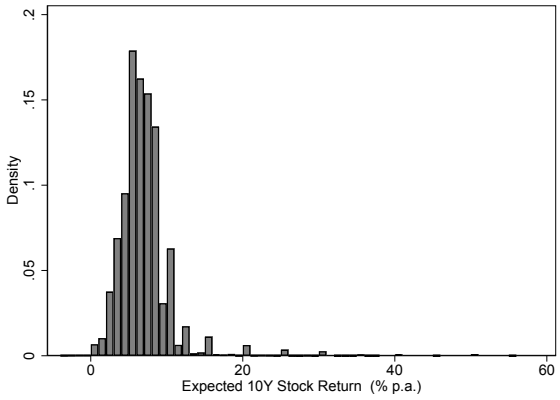
Distribution of Survey Responses. Figure A.4 presents histograms showing the full distributions of answers for six central questions from the GMSU-Vanguard survey. These figures reinforce our conclusion that there is very substantial heterogeneity in reported beliefs. We also find that the distribution of beliefs over 1-year expected returns is substantially wider than the distribution of beliefs over expected annualized 10-year returns.

Figure A.4: Distribution of Responses to Expectation Survey

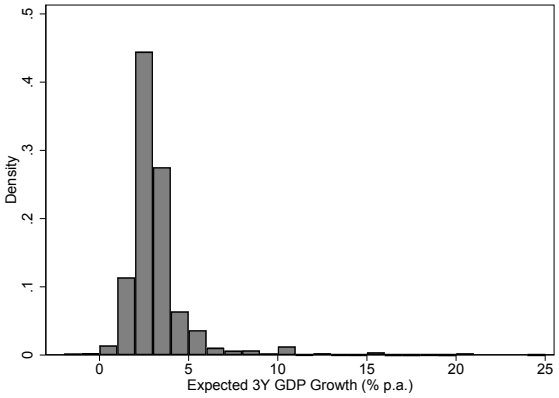
(A) 1-Year Expected Stock Returns



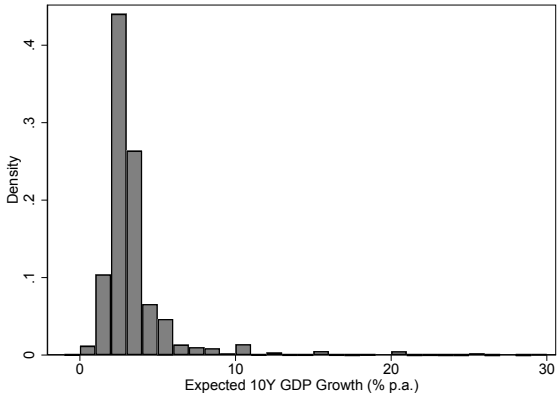
(B) 10-Year Expected Stock Returns (annualized)



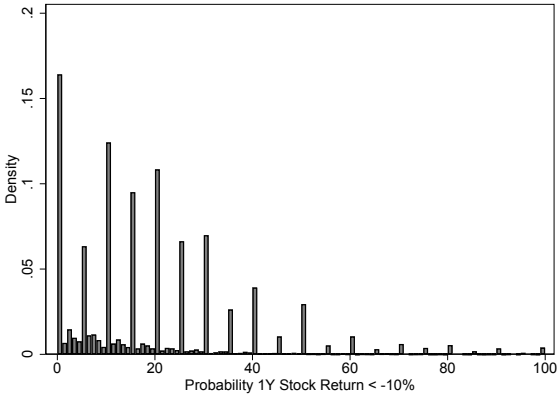
(C) 3-Year Expected GDP Growth (annualized)



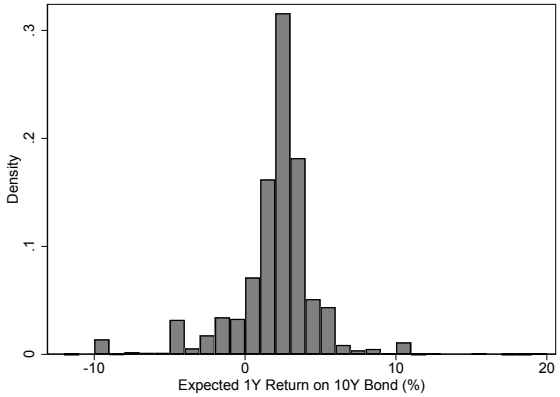
(D) 10-Year Expected GDP Growth (annualized)



(E) Probability of Stock Market Disaster



(F) 1-Year Expected Bond Returns



Note: Figure shows histograms of answers across the responses to the first fifteen waves of the GMSU-Vanguard survey.

Table A.3: Correlation Across Survey Responses

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Expected 1Y Stock Return (%)	1								
(2) Expected 10Y Stock Return (% p.a.)	0.322	1							
(3) Probability 1Y Stock Return in Bucket (%)	-0.217	-0.066	1						
(4) St.D. Expected 1Y Stock Return (%)	-0.095	0.012	0.570	1					
(5) Expected 3Y GDP Growth (% p.a.)	0.241	0.193	-0.035	0.056	1				
(6) Expected 10Y GDP Growth (% p.a.)	0.119	0.262	0.006	0.077	0.665	1			
(7) Probability p.a. 3Y GDP Growth in Bucket (%)	-0.136	-0.064	0.438	0.367	-0.052	0.011	1		
(8) St.D. Expected 3Y GDP Growth (% p.a.)	0.036	0.059	0.271	0.582	0.228	0.237	0.454	1	
(9) Expected 1Y Return of 10Y zero coupon bond (%)	0.127	0.108	-0.012	0.018	0.152	0.150	0.017	0.080	1

Note: Table shows within-survey correlations across questions eliciting beliefs about different objects.

Table A.3 shows the correlation across responses to different belief questions in the GMSU-Vanguard survey. These correlations echo a number of findings in the main body of the paper. Short-run and long-run beliefs about different objects are positively correlated. Consistent with Fact 4, beliefs about GDP growth and expected stock returns are also positively correlated. Consistent with Fact 5, individuals who report a higher probability of a stock market crash also report lower expected stock returns and a higher probability of a GDP disaster. Beliefs about expected bond returns are weakly positively correlated with expected stock returns, and uncorrelated with the probability of either a stock market disaster or a GDP disaster.

A.5 Baseline Regressions: Re-weighted Sample

In Section I, we discussed that the sample of survey respondents differs from the sample of non-respondents on a number of dimensions. In this Appendix, we repeat our baseline analysis in Section II on a sample of respondents designed to match the sample of non-respondents on a number of demographic characteristics. In this approach, we first pool the sample of respondents and non-respondents, and regress an indicator of whether a person responded on a number of observable characteristics such as age, gender, and wealth. The fitted values from this regression provide, for each individual who received the invitation to take a survey, the corresponding propensity to respond to the survey.

We then create a new regression sample that includes, for each non-respondent, the respondent with the closest propensity score. Since we have more non-respondents than respondents, we match to the distribution of respondents with replacement. We then run our baseline regression 1 on this new sample. The results, based on samples that are re-weighted across different dimensions, are shown in Table A.4.

Column 1 shows the baseline specification corresponding to column 5 in Table III. Column 2 shows the same regression on a sample of non-respondents that match our sample of respondents on the age and wealth dimensions. The average sensitivity in that sample is somewhat lower, consistent with the fact that wealthier people are both more sensitive and more likely to respond to the survey. In the following columns, we construct regression samples based on propensity scores built on age, gender, and wealth (column 3), and age, gender, wealth, and length of Vanguard relationship (column 4). The sensitivities in these samples are marginally smaller than in column 2. Overall, these results highlight that individuals who are more likely to respond to the survey have a somewhat higher sensitivity of portfolio shares to beliefs.

Table A.4: Beliefs and Portfolios: Re-weighted Sample

	Equity Share (%)			
	(1)	(2)	(3)	(4)
Expected 1Y Stock Return (%)	1.387***	1.291***	1.256***	1.198***
	(0.089)	(0.134)	(0.133)	(0.136)
Controls	Y	Y	Y	Y
ORIV	Y	Y	Y	Y
Sample	Baseline	Reweighted: Age + Wealth	Reweighted: Age + Wealth + Gender	Reweighted: Age + Wealth + Gender + Length of Relationship
N	30,733	150,097	150,097	150,097

Note: Table shows results from regression 1. Column 1 shows the baseline specification corresponding to column 5 in Table III. The following columns show the same regression but on a sample of respondent that are re-weighted to match the sample of non-respondents on a number of demographics: age and wealth (column 2); age, wealth, and gender (column 3); and age, wealth, gender, and length of Vanguard relationship (column 4). Significance levels: * ($p<0.10$), ** ($p<0.05$), *** ($p<0.01$).

A.6 Other Beliefs and Portfolios

In the main body of the paper, we explored the role that an individual's expectations of 1-year stock returns have on her portfolio allocation. In this Appendix, we explore how beliefs about other moments of stock returns as well as beliefs about bond returns and GDP growth affect these portfolio allocations. Since we are not able to instrument for most of these other beliefs, we return to estimating basic tobit models instead of ORIV models.

In column 1 of Table A.5, we control for the subjective standard deviation of 1-year stock returns, in addition to the point estimate for expected returns.[2] This completes our analysis of the Merton (1969) model by allowing individual-level variation in both the level and the standard deviation of expected returns. A higher standard deviation of returns has a statistically significant negative effect on the equity share. The estimated sensitivity of portfolio shares to 1-year expected stock returns is unchanged when controlling for the standard deviation.

Table A.5: Long-Run Beliefs, Variance, Tail Risk, and Bond Returns

	Equity Share (%)						Fixed Inc. Share (%)	Cash Share (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Expected 1Y Stock Return (%)	0.918***	0.883***		0.773***	0.797***	0.796***	-0.452***	-0.469***
	(0.054)	(0.054)		(0.058)	(0.059)	(0.061)	(0.055)	(0.052)
Standard Deviation 1Y Stock Return (%)	-0.140**	-0.029		-0.047	-0.029	-0.017	0.078	-0.056
	(0.052)	(0.058)		(0.059)	(0.060)	(0.062)	(0.058)	(0.052)
Probability 1Y Stock Return < -30%		-0.129***	-0.208***	-0.108***	-0.097**	-0.101**	0.024	0.057
		(0.032)	(0.028)	(0.033)	(0.033)	(0.035)	(0.031)	(0.031)
Probability 1Y Stock Return∈ [-30%,-10%)			-0.179***					
			(0.020)					
Probability 1Y Stock Return∈ [30%,40%)			0.003					
			(0.022)					
Probability 1Y Stock Return > 40%			0.018					
			(0.040)					
Expected 10Y Stock Return (%)				0.450***	0.474***	0.544***	-0.480***	-0.177**
				(0.075)	(0.077)	(0.085)	(0.078)	(0.068)
Expected 1Y Return of 10Y bond (%)					-0.211*	-0.199*	0.665***	-0.373***
					(0.089)	(0.092)	(0.084)	(0.077)
Expected 3Y GDP Growth (% p.a.)						0.021	-0.234	0.047
						(0.151)	(0.143)	(0.121)
Expected 10Y GDP Growth (% p.a.)						-0.022	0.203	-0.200*
						(0.122)	(0.113)	(0.095)
Controls + Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
N	30,733	30,733	31,338	30,145	29,435	28,492	28,492	28,492

Note: Table shows summary results from tobit regression 1, where we also include other beliefs elicited by the survey. The dependent variable in columns 1 to 6 is the equity share; in column 7 it is the fixed income share, and in column 8 it is the cash share. Standard errors are clustered at the respondent level. Significance levels: * ($p<0.10$), ** ($p<0.05$), *** ($p<0.01$).

[2] To construct the implied standard deviation from the distribution question, we first split each bucket into ranges of 5 percentage points. For each of these ranges, we compute the historical probability of being in that range. We then weight these probabilities by the subjective probability of each bucket reported by the respondent. We finally calculate the standard deviation based on the mid-points of the narrower ranges, and their associated subjective probabilities.

Once we move away from the first and second moment of expected returns, or when we consider beliefs about long-run stock returns, we lose the benchmark of a simple asset pricing model that can be used to assess the quantitative relationship between beliefs and portfolios. We therefore view the estimates presented in the rest of this section as providing guidance for future asset pricing theories wanting to focus on the relevant moments of the belief distribution.

In column 2 of Table A.5, we control for the probability that individuals assign to a stock market decline of more than 30%. As discussed in Section VI, the probability of these rare disasters plays a prominent role in many macro-finance theories of portfolio formation and, in general equilibrium, of asset returns. Indeed, we find that a higher probability of a rare disaster is associated with declines in the equity portfolio share. A one-standard deviation increase in the perceived stock market disaster probability is associated with about a one percentage point lower equity share. In addition, after including controls for the perceived disaster probability, differences in the perceived standard deviation of expected returns is no longer associated with significant differences in equity shares.

In column 3, we separately include the probabilities that individuals assign to each of the five buckets of possible realizations of equity returns. Since these probabilities add up to 100%, we drop the middle bucket. Shifting subjective probability mass from the middle bucket to the low-outcome buckets is associated with substantial declines in the equity share, while shifts to high-outcome buckets lead to only small and statistically insignificant increases in the equity share. This is consistent with concavity in the utility function, so that moving mass to negative states in which marginal utility is high has disproportionately large effects on portfolio choice. It is also reminiscent of models of loss aversion and downside-risk in which agents are disproportionally worried about returns below a certain cutoff point.[3]

In column 4, we include an individual's beliefs about the annualized stock return over the coming ten years in addition to the beliefs about the expected stock returns over the coming year. Short-horizon and long-horizon stock-market return expectations are positively correlated (see the discussion of Fact 4 in Section V), but long-run expectations matter for portfolio allocation even after controlling for short-run expectations. Interestingly, the magnitudes of the effects are similar for long-run and short-run expectations. These results suggest that individuals choose their portfolio for the long-run, particularly since they do not adjust it frequently, and do not behave myopically by only focusing on their short-run expectations.[4]

In column 5, we also include controls for a respondent's beliefs about the 1-year return of a 10-year risk-free bond. Holding fixed beliefs about equity returns, increased optimism about bond returns is associated with a lower equity share. Finally, column 6 also includes controls for GDP growth expectations, but these do not have an effect on portfolio shares over and above the stock market and bond market expectations. This is consistent with the vast majority of models in which expectations of cash flows contribute to the level of asset prices, but only expectations about returns influence portfolio choice.

[3] See Tversky and Kahneman (1991); Benartzi and Thaler (1995); Ang, Chen and Xing (2006); Lettau, Maggiori and Weber (2014).

[4] A large literature has studied the investment problem of a long-run investor; see for example Merton (1975); Barberis (2000); Brennan, Schwartz and Lagnado (1997); Campbell and Viceira (1999, 2001); Campbell et al. (2002).

Overall, the findings in this section suggest that the relationship between beliefs and portfolio allocations is more complex than suggested by the simple Merton (1969) model. First, the subjective risk of large stock market declines has larger effects on portfolio allocations than the subjective variance. Second, long-run stock market beliefs matter in addition to short-run beliefs. Third, beliefs about other investments, including fixed income investments, also influence the optimal equity share. We hope that these findings can help guide the development of future macro-finance models that explore the relationship between beliefs, portfolios, and ultimately asset prices.

Substitution Patterns. The previous discussion explored the relationship between various beliefs (about stock returns, bond returns, and GDP growth) and the equity share in investors' portfolios. In columns 7 and 8 of Table A.5, we instead use the fixed income share and the cash share as the dependent variables, allowing us to explore the substitution between stocks, bonds, and cash. About half of the increase in equity shares of individuals who expect higher stock market returns comes from individuals substituting away from cash rather than individuals substituting away from fixed income securities. This is despite the fact that the average fixed income share is substantially larger than the average cash share. Similarly, we find that increases in expected bond returns are associated with increases in the fixed income share, with much of the adjustment coming from reductions in the cash share instead of the equity share. The sensitivity of the bond portfolio shares to bond expected returns is even lower than the corresponding one for equities. Indeed, a back-of-the-envelope calculation is again very illustrative. We can apply the Merton (1969) formula in equation 2 by replacing equities with bonds and using the historical standard deviation of long-term Treasury-bond returns of around 5%. The estimate of $\beta = 0.665$ from column 7 of Table A.5 implies a coefficient of relative risk aversion above 500. We conclude that fixed income offers a similar picture as equities: portfolios co-move with beliefs, but substantially less so than implied by frictionless benchmark models.

A.7 Trading: Data and Further Results

In this Appendix, we provide more details on the data construction for our trading analysis, as well as some additional results from our analysis of investor trading behavior. For investors with retail accounts (which are 80% of the investors we contacted), we observe transaction-level data since January 2011.

For each trade by an investor in our sample, we observe the day of the trade, the amount traded, and the CUSIP and ticker of the traded security. We also observe the asset class composition of each security (individual security or fund) as the percentage invested in equity, fixed-income, cash, other, and unknown (we group other and unknown together). The classification is provided to us directly by Vanguard. For individual securities, the classification is relatively obvious: equity securities are classified as 100% equity, bonds as 100% fixed income. For mutual funds and ETFs, Vanguard relies on both internal data (for Vanguard operated funds) and external data (from Morningstar) to divide the investment of the funds into the various asset classes. Our data also contains a code that describes the type of transaction: whether it is a purchase of an asset with cash, a sale, an exchange of two different stocks, a purchase with cash from outside Vanguard, and

so on. We use this information to compute, for each trade, how the portfolio allocation into equity, fixed income, cash and other investments (as well as outside money) changes as a result of the trade. We do so by combining the information about the type of trade, the dollar amount of the trade, and the allocation of the asset traded into asset classes.

We divide our sample period in two-week "intervals" (for each month, from the 1st to the 15th of the month, and from the 16th to the end of the month). We chose these two-week increments because our survey is administered around the 15th of the month. Each trade is then assigned to the corresponding interval, and all trades are aggregated by interval. This procedure yields, for each interval, the total increase and decrease for equity, fixed income, cash, and other and unknown in the portfolio as a result of an active trade during the interval. We also obtain the total inflow/outflow of money from Vanguard and the total volume of trade during the interval.

We then merge this transaction data with the portfolio data, which provides snapshots of the portfolios held at the end of each month. We can then compute the change during the interval in the fraction of the portfolio allocated to equity, fixed income, cash and other due to trading. For intervals starting on the 16th of the month (for which we do not observe the snapshot of the market value of the portfolio at that point in time), we use instead the imputed value of the portfolio combining the beginning-of-month portfolio value and the change in value due to trading during the first two weeks. The analysis in the main body of the paper focuses on "windows" between any two consecutive surveys answered by each individual. For example, an individual might have answered waves 1 and 3 of the survey, so that a four-month window has passed between the two answers. For the analysis in the paper, we aggregate all the 15-day intervals over those four months to focus on trading that occurred during the window.

Table A.6 is the same as Table V in the paper, but additionally reports the coefficients on the control variables. Younger, wealthier, and male respondents are all more likely to trade in any given period. There does not seem to be substantial variation in trading propensity across regions.

Table A.6: Trading Analysis

	Δ Equity Share (%)	Probability Trade	Probability Trade	Probability Buy	Δ Equity Share (%)
	(1)	(2)	(3)	(4)	(5)
Δ Expected 1Y Stock Return (%)	0.346***			2.119***	0.941***
	(0.065)			(0.436)	(0.178)
Expected 1Y Stock Return (%)	0.174***		-0.07	2.101***	0.563***
	(0.026)		(0.206)	(0.299)	(0.086)
Lagged Equity Share (%)	-0.041***		-0.097***	-0.322***	-0.137***
	(0.004)		(0.027)	(0.044)	(0.014)
|Δ Expected 1Y Stock Return (%) |			-0.038		
			(0.465)		
Male	-0.208		4.379***	-1.403	-0.655
	(0.154)		(1.051)	(2.124)	(0.608)
Age ∈ [40, 50]	0.279		-4.196	-0.096	-0.332
	(0.376)		(2.391)	(4.577)	(1.294)
Age ∈ [50, 60]	-1.213***		-4.782*	-7.988*	-3.907***
	(0.351)		(2.148)	(3.923)	(1.173)
Age ∈ [60, 70]	-1.062**		-6.547**	-7.666*	-3.549**
	(0.330)		(2.093)	(3.870)	(1.111)
Age > 70	-0.887**		-7.082**	-8.456*	-3.180**
	(0.328)		(2.156)	(3.932)	(1.119)
Region North	0.242		0.515	2.835	0.794
	(0.192)		(1.428)	(2.647)	(0.716)
Region South	0.338		1.783	1.348	0.92
	(0.182)		(1.388)	(2.580)	(0.668)
Region West	0.325		0.826	-0.06	0.754
	(0.190)		(1.384)	(2.600)	(0.678)
Wealth Quintile 2	0.145		1.576	-1.329	-0.249
	(0.258)		(1.415)	(3.535)	(1.229)
Wealth Quintile 3	-0.144		6.494***	-3.486	-0.368
	(0.227)		(1.544)	(3.407)	(1.059)
Wealth Quintile 4	-0.134		10.902***	-5.981	-0.214
	(0.242)		(1.625)	(3.345)	(1.081)
Wealth Quintile 5	-0.035		12.308***	-3.643	0.074
	(0.238)		(1.618)	(3.348)	(1.060)
Lagged Equity Share = 0%	0.126	-25.800***	-27.119***	29.446***	32.611***
	(0.649)	(1.977)	(2.249)	(4.437)	(5.903)
Lagged Equity Share = 100%	0.694**	-26.695***	-19.862***	-19.360***	-12.181***
	(0.262)	(1.118)	(1.238)	(5.095)	(3.369)
Wave Dummies	Y	Y	Y	Y	Y
Specification				Conditional on Trading	Conditional on Trading
R-Squared	0.029	0.338	0.352	0.504	0.16
N	12,942	13,396	12,942	3,529	3,529

Note: This table is the same as Table V, but shows all coefficient estimates, instead of only focusing on the coefficient estimates for the main variables of interest.

A.8 Beliefs and Demographics

In Section IV, we documented that individual fixed effects are the most important component for explaining the panel variation in beliefs: optimists are persistently optimistic and pessimists are persistently pessimistic. We also highlighted that demographic characteristics struggle to explain which individuals are optimistic and which ones are pessimistic. To show this fact, the main body of the paper focused on documenting the relatively low R^2s from regressions of the individual fixed effects on demographic characteristics.

Table A.7 shows the coefficients on the control variables from these regressions. Despite the low R^2s, a number of systematic patterns emerge. First, in our sample, older individuals are somewhat more optimistic about expected stock returns and about 3-year GDP growth; their subjective distribution over future stock returns also has a lower standard deviation, and they assign smaller probabilities to extreme events such as large stock market declines. There is no large difference between men and women in terms of their stock market expectations, but men expect both GDP growth and bond returns to be lower.

We also find that wealthier individuals are substantially more pessimistic across most of their beliefs. Interestingly, while they report lower expected returns, wealthier respondents also perceive a lower standard deviation of expected returns and assign smaller probabilities to extreme negative realizations of stock market returns and GDP growth. This finding suggests that perceived Sharpe ratios decline less in wealth than expected returns do. Individuals who log into their Vanguard accounts more frequently are somewhat more optimistic about stock returns. Across Census regions, there is some evidence that residents from the Western region are somewhat more pessimistic, both in terms of expected stock returns and expected GDP growth. Individuals from the Western region also assign larger probabilities to extreme negative realizations of stock market returns and GDP growth.

We also find that individuals who have experienced higher equity returns since 2011 are more optimistic about future stock market returns (and perceive a lower probability of a stock market disaster), while respondents who experienced a higher return on their fixed income assets perceive higher subjective future bond returns.[5] These results mirror findings from a large literature that has documented how individuals extrapolate from their own experience when forecasting future economic outcomes. Prominent contributions to that literature include Amromin and Sharpe (2009), Greenwood and Shleifer (2014), Malmendier and Nagel (2011), Malmendier and Nagel (2016), Malmendier, Nagel and Yan (2017), and Kuchler and Zafar (2015).[6]

[5] We measure these past returns as the geometric average of the monthly equity returns in the portfolios of those individuals between January 2011 and January 2017, expressed in percentage points. For individuals for whom we do not observe such a long portfolio history, we replace this value with "999", while adding a dummy variable that captures these observations. See Dickens and Katz (1987) and Giglio, Maggiori and Stroebel (2015) for a description of this procedure and a discussion of different approaches to dealing with missing characteristics.

[6] Note that the time-series of average beliefs presented in Appendix A.3 also provides suggestive evidence for extrapolative behavior in the belief formation of the average individual: for example, the biggest drop in expected returns occurred in the December 2018 wave, just following a substantial decline in U.S. stock markets. However, given the short time-series of our survey, we do not focus on these patterns.

Table A.7: Beliefs by Demographics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Expected 1-Year Stock Returns	Expected 10-Year Stock Returns	Probability 1-Year Stock Returns < -30%	St. D. Expected 1-Year Stock Returns	Expected 3-Year GDP Growth	Expected 10-Year GDP Growth	Probability 3-Year GDP Growth < -3%	St. D. Expected 3-Year GDP Growth	Expected 1-Year Bond Returns
Male	-0.005	-0.014	0.558	0.576***	-0.130**	-0.346***	0.504	0.042	-0.198**
	(0.177)	(0.105)	(0.557)	(0.143)	(0.055)	(0.070)	(0.493)	(0.035)	(0.090)
Age ∈ [40, 50]	-0.663*	-0.001	1.276	-0.21	-0.161	-0.202	-0.083	-0.102	0.06
	(0.398)	(0.236)	(1.252)	(0.322)	(0.125)	(0.157)	(1.107)	(0.079)	(0.203)
Age ∈ [50, 60]	0.233	0.006	-1.898*	-0.738***	0.014	-0.048	-3.040***	-0.185***	-0.072
	(0.349)	(0.207)	(1.099)	(0.282)	(0.109)	(0.137)	(0.971)	(0.070)	(0.178)
Age ∈ [60, 70]	0.230	-0.241	-3.064***	-1.175***	0.140	0.003	-4.744***	-0.214***	-0.025
	(0.334)	(0.198)	(1.052)	(0.270)	(0.105)	(0.132)	(0.930)	(0.067)	(0.170)
Age > 70	0.477	0.017	-5.159***	-1.705***	0.367***	0.289**	-6.559***	-0.251***	0.113
	(0.344)	(0.204)	(1.084)	(0.278)	(0.108)	(0.136)	(0.958)	(0.069)	(0.175)
Region North	-0.135	0.218*	0.141	-0.155	0.051	0.110	-0.977	-0.055	0.047
	(0.223)	(0.132)	(0.701)	(0.180)	(0.070)	(0.088)	(0.620)	(0.044)	(0.113)
Region South	0.118	0.363***	0.108	-0.151	0.106	0.152*	-0.235	-0.023	0.086
	(0.210)	(0.125)	(0.661)	(0.170)	(0.066)	(0.083)	(0.585)	(0.042)	(0.107)
Region West	-0.709***	0.053	2.019***	0.128	-0.133*	-0.006	1.171*	-0.035	-0.069
	(0.221)	(0.131)	(0.694)	(0.178)	(0.069)	(0.087)	(0.614)	(0.044)	(0.112)
Wealth Quintile 2	-0.791***	-0.278*	1.107	-0.248	-0.297***	-0.281***	-0.317	-0.154***	-0.251**
	(0.241)	(0.143)	(0.759)	(0.195)	(0.076)	(0.095)	(0.671)	(0.048)	(0.123)
Wealth Quintile 3	-0.542**	-0.174	0.427	-0.520**	-0.289***	-0.275***	-0.651	-0.203***	-0.258**
	(0.251)	(0.149)	(0.790)	(0.203)	(0.079)	(0.099)	(0.699)	(0.050)	(0.128)
Wealth Quintile 4	-0.422	-0.163	-0.506	-0.473**	-0.246***	-0.182*	-1.133	-0.208***	-0.428***
	(0.264)	(0.157)	(0.832)	(0.214)	(0.083)	(0.104)	(0.736)	(0.053)	(0.135)
Wealth Quintile 5	-0.662**	-0.348**	-0.126	-0.611***	-0.357***	-0.358***	-1.410*	-0.249***	-0.795***
	(0.281)	(0.167)	(0.884)	(0.227)	(0.088)	(0.111)	(0.781)	(0.056)	(0.143)
Days With Visits Quintile 2	-0.368	-0.149	0.158	-0.115	-0.068	-0.129	-0.156	-0.006	-0.084
	(0.236)	(0.140)	(0.741)	(0.190)	(0.074)	(0.093)	(0.656)	(0.047)	(0.120)
Days With Visits Quintile 3	0.236	0.076	-0.267	0.036	-0.078	-0.130	-1.087	0.032	-0.102
	(0.243)	(0.144)	(0.765)	(0.196)	(0.076)	(0.096)	(0.676)	(0.048)	(0.124)
Days With Visits Quintile 4	0.457*	0.207	0.025	0.132	-0.048	-0.162*	-0.931	-0.019	0.003
	(0.247)	(0.147)	(0.779)	(0.200)	(0.077)	(0.097)	(0.689)	(0.049)	(0.126)
Days With Visits Quintile 5	0.766***	0.300**	0.018	0.164	-0.061	-0.176*	-0.966	-0.017	0.048
	(0.250)	(0.148)	(0.786)	(0.202)	(0.078)	(0.098)	(0.695)	(0.050)	(0.127)
Confidence 1	0.383	0.568	-0.160	-0.081	0.167	0.059	0.453	-0.074	-0.485
	(0.661)	(0.392)	(2.079)	(0.534)	(0.207)	(0.260)	(1.839)	(0.132)	(0.337)
Confidence 2	1.161*	1.121***	-3.191	-1.512***	0.195	0.031	-2.750	-0.267**	-0.475
	(0.639)	(0.379)	(2.011)	(0.516)	(0.200)	(0.252)	(1.778)	(0.127)	(0.325)
Confidence 3	2.215***	1.550***	-7.496***	-3.099***	0.279	0.067	-6.238***	-0.549***	-0.385
	(0.649)	(0.385)	(2.044)	(0.525)	(0.203)	(0.256)	(1.807)	(0.130)	(0.331)
Confidence 4	2.374***	1.487***	-11.133***	-5.644***	0.469*	0.122	-9.195***	-1.007***	-0.463
	(0.783)	(0.464)	(2.465)	(0.633)	(0.246)	(0.309)	(2.179)	(0.156)	(0.400)
Equity return since 2011	0.048**	0.024*	-0.198***	-0.022	0.001	0.010	-0.115*	-0.002	0.013
	(0.022)	(0.013)	(0.070)	(0.018)	(0.007)	(0.009)	(0.062)	(0.004)	(0.011)
Fixed income return since 2011	-0.027	-0.009	0.102	0.013	0.000	-0.003	0.181*	0.004	0.042**
	(0.036)	(0.022)	(0.114)	(0.029)	(0.011)	(0.014)	(0.101)	(0.007)	(0.019)
R-Squared	0.051	0.042	0.066	0.129	0.034	0.036	0.078	0.07	0.038
N	3,152	3,150	3,151	3,151	3,151	3,150	3,151	3,151	3,148

Note: Table shows coefficients of regressions of respondent fixed effects for answers to the various survey questions on demographic controls. We include fixed effects for all individuals for whom we observe at least three responses. Standard errors are clustered at the respondent level. Significance levels: * ($p<0.10$), ** ($p<0.05$), *** ($p<0.01$).

A.9 Variance Decomposition of Beliefs – RAND Survey

In this Appendix, we repeat the variance decomposition of beliefs from Section IV using the RAND survey. The RAND survey covers a smaller cross-section (4,734 individuals) but a longer time series than the GMSU-Vanguard survey, with 1,032 individuals responding at least 50 times.

Table A.8: Decomposing Variation in Beliefs: Individual and Time Fixed Effects (RAND)

	R^2 (%)			
	Reg (4)	Reg (5)	Reg (6)	N
Prob. Ret > 0% (1yr)	0.5	56.8	57.4	3,475
Prob. Ret > 20% (1yr)	1.4	47.1	48.2	3,358
Prob. Ret < -20% (1yr)	0.5	45.9	46.4	3,442
Prob. Ret > 0% (10yr, cumul.)	1.5	67.4	68.4	3,475
Prob. Ret > 20% (10yr, cumul.)	3.8	53.3	56.1	3,052
Prob. Ret < -20% (10yr, cumul.)	0.4	49.3	49.5	2,996

Note: Table shows R^2s corresponding to the three regressions 4, 5, and 6, using the RAND survey. Each row corresponds to a different question in the survey.

In Table A.8, we repeat the analysis from Table VI in the main body, and report the share of total variance that is explained by time fixed effects, individual fixed effects, and both. We require that individuals have responded at least three times, consistent with Table VI that uses the GMSU-Vanguard survey. We perform the analysis using six different questions asked in the RAND survey: the probability that the 1-year return is above 0%, above 20%, or below -20%, and the probability that the cumulative 10-year return is above 0%, above 20%, or below -20%. Table A.9 repeats the robustness exercise from Table VII, and increases the number of responses required to be included in the analysis from 3 to 50. Both tables show results qualitatively and quantitatively similar to the ones in the GMSU-Vanguard survey. In particular, the individual fixed effects explain about 45-70% of the total variation, while the time fixed effects explain only 1-4%.

Table A.9: Decomposing Variation in Beliefs: Robustness (RAND)

Panel A: R^2 (total, %)	#Resp≥3	#Resp≥4	#Resp≥5	#Resp≥6	#Resp≥10	#Resp≥30	#Resp≥50
Prob. Ret > 0% (1yr)	56.8	56.8	56.8	56.8	56.9	57.9	58.1
Prob. Ret > 20% (1yr)	47.1	47.0	46.9	46.8	46.8	46.6	47.0
Prob. Ret < -20% (1yr)	45.9	45.9	45.8	45.8	45.9	45.5	49.1
Prob. Ret > 0% (10yr, cumul.)	67.4	67.4	67.4	67.4	67.6	68.7	70.2
Prob. Ret > 20% (10yr, cumul.)	53.3	53.2	53.1	53.0	52.7	-	-
Prob. Ret < -20% (10yr, cumul.)	49.3	49.3	49.2	49.1	48.2	-	-

Panel B: N. of obs.	#Resp≥3	#Resp≥4	#Resp≥5	#Resp≥6	#Resp≥10	#Resp≥30	#Resp≥50
Prob. Ret > 0% (1yr)	3,475	3,349	3,211	3,135	2,737	977	552
Prob. Ret > 20% (1yr)	3,358	3,215	3,067	2,970	2,587	932	510
Prob. Ret < -20% (1yr)	3,442	3,305	3,163	3,077	2,667	954	520
Prob. Ret > 0% (10yr, cumul.)	3,475	3,345	3,205	3,123	2,728	973	555
Prob. Ret > 20% (10yr, cumul.)	3,052	2,836	2,654	2,425	1,156	-	-
Prob. Ret < -20% (10yr, cumul.)	2,996	2,780	2,576	2,348	1,122	-	-

Note: Panel A reports the R^2 statistics corresponding to regression 5. Across columns, we increase from 3 to 50 the minimum number of responses for an individual to be included in the sample. Panel B reports the number of observations. Each row corresponds to a different question in the survey.

A.10 Persistent Heterogeneity in Beliefs & Portfolio Shares

Our main analysis explores the relationship between beliefs and portfolios in our panel of respondents. Since individual beliefs are extremely persistent, we next study the persistence of portfolio shares and examine the relationship between the persistent components of beliefs and portfolios.

We begin by performing a variance decomposition of the equity share similar to the one in Section IV, restricting to respondents for which we observe at least 12 months of portfolio data. We find even more extreme results than we do for beliefs: month fixed effects explain about 0.1% of the total variation in equity shares, whereas individual fixed effects explain 90% of the variation.

We next compute individual-level fixed effects for the equity share and for the belief about 1-year expected stock returns. Column 1 of Table A.10 reports the results of a cross-sectional tobit regression of the equity share fixed effect onto the expected return fixed effects, for respondents that answer our survey at least three times. The slope of the regression, 1.3, is similar in magnitude to the one from our panel analysis in Table III, confirming that our main empirical results are mostly driven by persistent cross-sectional differences across individuals. Column 4 restricts the sample to fixed effects estimated off at least 5 responses, and finds even larger responses, consistent with us obtaining more precise estimates of the fixed effects.

Table A.10: Explaining Equity Shares with Individual Belief Fixed Effects

	Equity Share (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
	Equity Share FE	2011 Equity Share	Equity Share	Equity Share FE	2011 Equity Share	Equity Share
Expected 1Y Stock Return (FE)	1.316***	0.796***	1.512***	1.433***	0.842**	1.566***
	(0.119)	(0.175)	(0.064)	(0.214)	(0.307)	(0.092)
Expected 1Y Stock Return (residual)			0.141			0.150
			(0.078)			(0.101)
Minimum number of responses	3	3	3	5	5	5
N	3,233	2,531	14,563	1,149	926	7,704

Note: Table shows the results of different specifications for the regression of equity share on beliefs, focusing on the persistent components. The independent variables are individual fixed effects of beliefs and the residual component, computed using at least 3 responses (columns 1-3) or at least 5 responses (columns 4-6). Columns 1 and 4 regress equity share fixed effects onto individual belief fixed effects. Columns 2 and 5 regress the 2011 portfolio share onto the belief fixed effects. Columns 3 and 6 regress the equity share onto the individual belief fixed effects and the residual component in the panel. All regressions are tobit regressions. Significance levels: * ($p<0.10$), ** ($p<0.05$), *** ($p<0.01$).

Since beliefs and portfolios are persistent, one would expect that current beliefs should relate strongly not only to the current equity share, but also to equity shares measured far outside our sample. In column 2, we regress the equity share of our respondents measured as of January 2011 onto the belief fixed effects computed from our survey sample (2017-2019). The relationship is somewhat weaker at around 0.8, but still of a similar magnitude. This confirms the importance of the persistent component of beliefs in explaining portfolio choices. Column 3 reverts to our panel analysis (as in our baseline results), but decomposes the panel variation in beliefs into the individual fixed effects and the residual (transitory) components. A tobit regression of portfolio shares onto the two components shows that it is the persistent component that dominates. The small role played by the transitory component of beliefs could partly reflect measurement error, and partly a slow adjustment of portfolios to beliefs due to infrequent trading, which would cause transitory variation in beliefs to not be fully incorporated into portfolios within our sample.

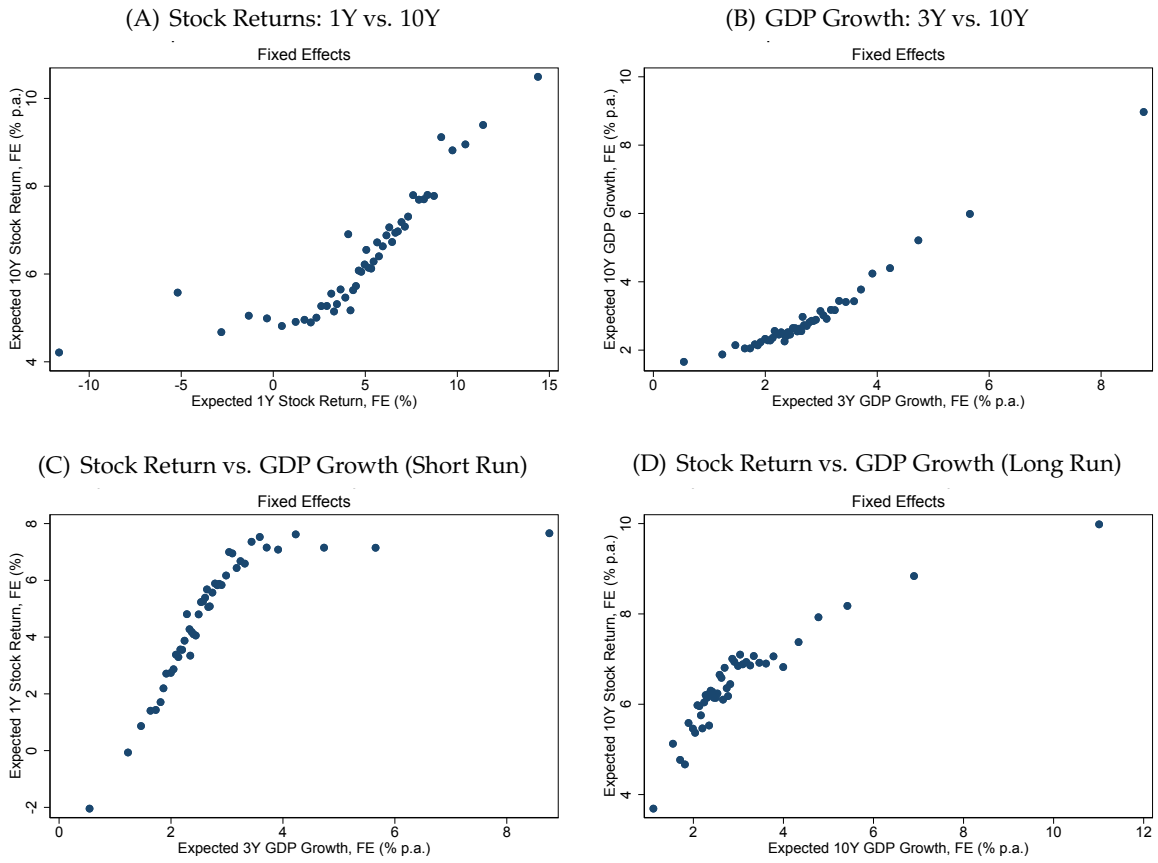
A.11 Relationship Among Beliefs: Persistent vs. Transitory

In Section V, we showed that beliefs correlate across domains and horizons: beliefs about stock returns correlate with beliefs about GDP growth, and short-term beliefs correlate with long-term beliefs about the same object. In this Appendix, we explore these relationships in greater detail, by repeating the analysis separately for the persistent and the transitory component of beliefs.

More specifically, we compute for each of the questions the individual fixed effects (capturing the persistent component of beliefs) and the residual (capturing the transitory component), and repeat our analysis relating only the fixed effects across questions (Figure A.5) as well as only the transitory component (Figure A.6).

Figure A.5 focuses on the persistent component only. It looks strikingly similar to Figure IV, emphasizing the importance of the persistent component of beliefs in our panel variation.

Figure A.5: Relationships Among Beliefs Within the Same Survey, FE



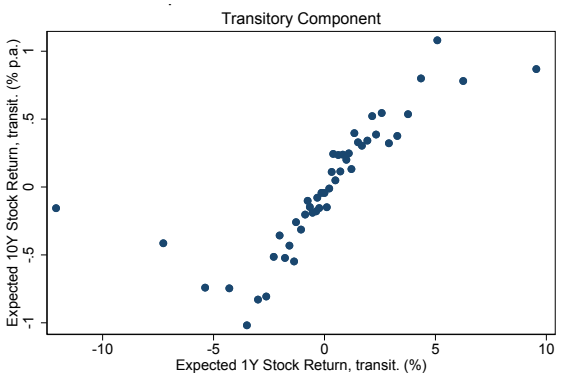
Note: Same as Figure IV, but using only individual fixed effects.

Figure A.6 resembles Figure IV less strongly, but it still confirms a positive correlation of answers across domains, even for the transitory component.

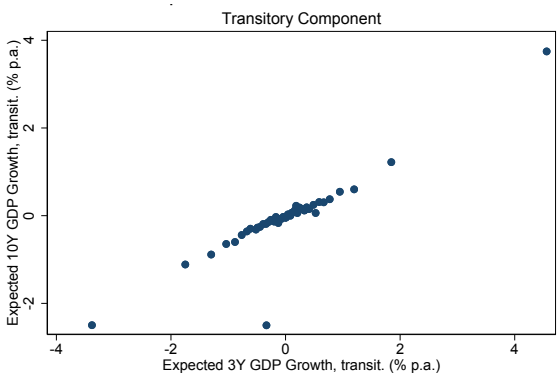
Overall, our results in this section establish that the pattern of correlation across domains documented in the text comes partly from the persistent component of beliefs, and partly from the transitory component, albeit more strongly for the former.

Figure A.6: Relationships Among Beliefs Within the Same Survey, Transitory

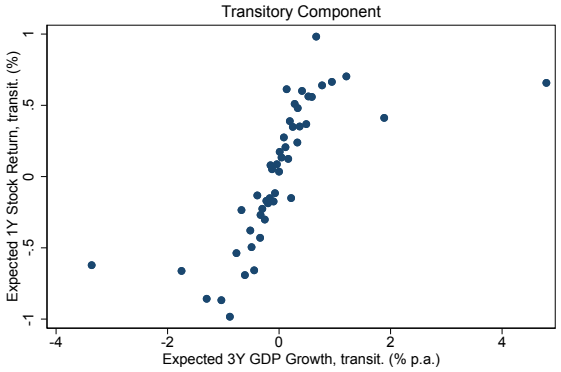
(A) Stock Returns: 1Y vs. 10Y



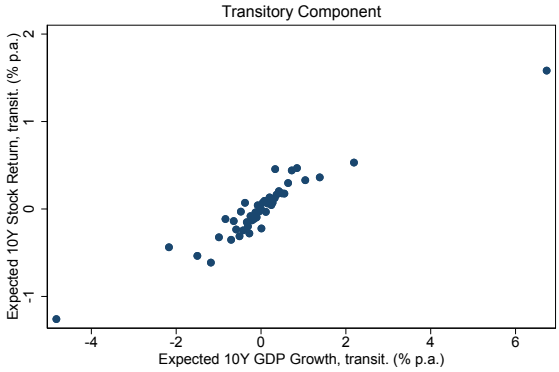
(B) GDP Growth: 3Y vs. 10Y



(C) Stock Return vs. GDP Growth (Short Run)



(D) Stock Return vs. GDP Growth (Long Run)

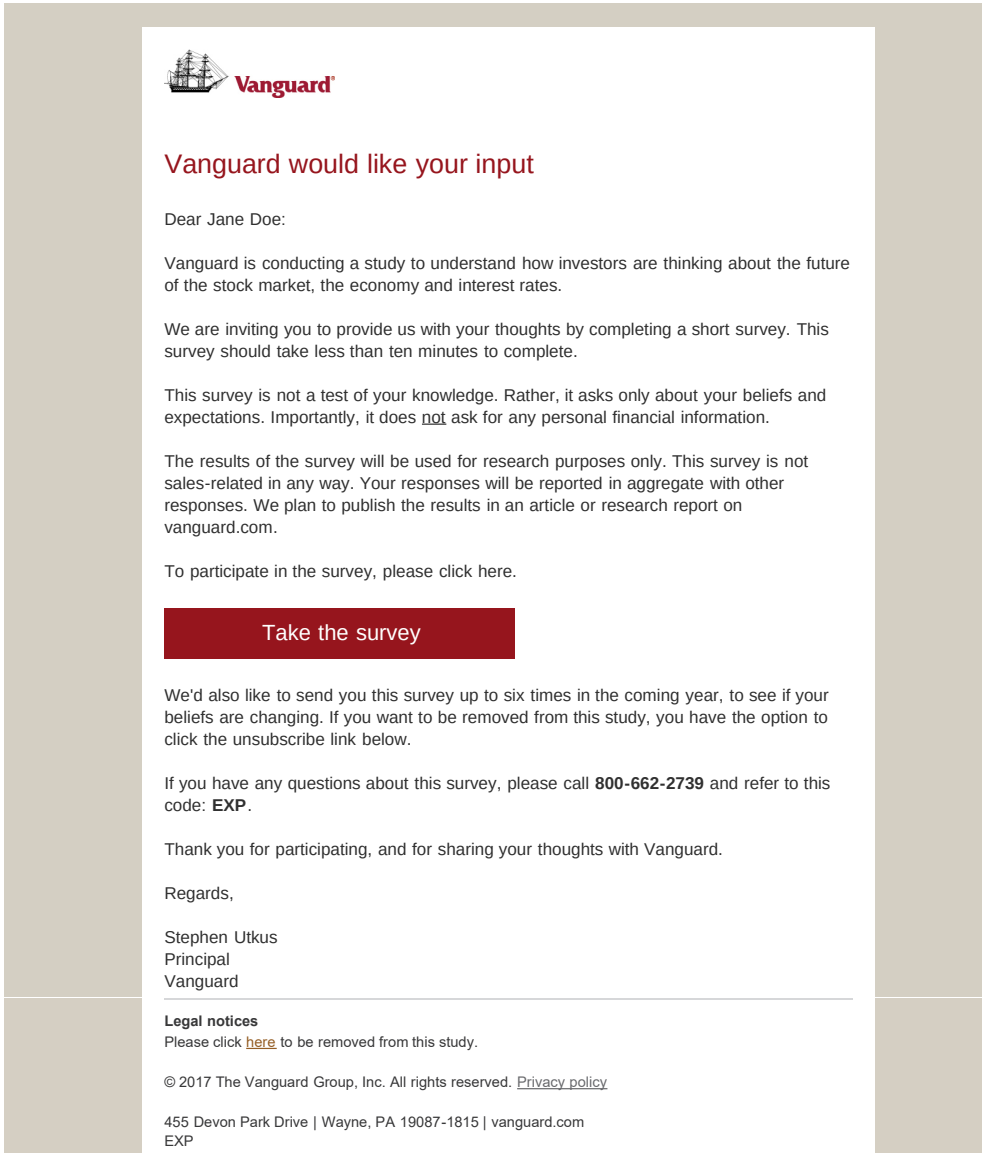


Note: Same as Figure IV, but using only the transitory component of beliefs.

B.1 Invitation Email and Survey Flow

In this Appendix, we present screenshots of one complete survey flow. In this iteration of the flow, questions about expected stock returns were asked ahead of questions about expected GDP growth; the survey implementation randomizes across these two blocks of questions. We begin by reviewing the invitation email sent to individuals from Vanguard.

Subject:	[TEST]We need your help, Jane Doe
From:	Vanguard (vanguard@eonline.e-vanguard.com)
To:	oea_test@yahoo.com;
Date:	Monday, February 13, 2017 10:58 AM



Vanguard

Vanguard would like your input

Dear Jane Doe:

Vanguard is conducting a study to understand how investors are thinking about the future of the stock market, the economy and interest rates.

We are inviting you to provide us with your thoughts by completing a short survey. This survey should take less than ten minutes to complete.

This survey is not a test of your knowledge. Rather, it asks only about your beliefs and expectations. Importantly, it does not ask for any personal financial information.

The results of the survey will be used for research purposes only. This survey is not sales-related in any way. Your responses will be reported in aggregate with other responses. We plan to publish the results in an article or research report on vanguard.com.

To participate in the survey, please click here.

Take the survey

We'd also like to send you this survey up to six times in the coming year, to see if your beliefs are changing. If you want to be removed from this study, you have the option to click the unsubscribe link below.

If you have any questions about this survey, please call **800-662-2739** and refer to this code: **EXP**.

Thank you for participating, and for sharing your thoughts with Vanguard.

Regards,

Stephen Utkus
Principal
Vanguard

Legal notices
Please click here to be removed from this study.

455 Devon Park Drive | Wayne, PA 19087-1815 | vanguard.com
EXP

radius GLOBAL MARKET RESEARCH

Vanguard

Dear Investor,

Thank you for participating in this study.

At Vanguard we are interested in understanding investor views on the future of the stock market, the economy and interest rates. We plan to create an investor sentiment index to share these findings with the investing public.

This is a short survey that should take you no more than 5-10 minutes to complete.

The survey does not collect any personal information. It relies on your general knowledge.

If you feel you are not familiar with a topic, that is fine. Please just give us your best prediction.

Please do not use the browser's navigation button to move through the survey.

Next

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For these questions, we would like to know what you are expecting the future returns of the US stock market to be.

Next

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What do you expect the return of the US stock market to be **over the next 12 months**?

Note: This expected return is the change in value, in percent, that you expect to receive **over the next 12 months** from investing in a portfolio that holds all stocks listed on the US stock market. It includes both dividends and capital gains/losses.

(Please answer only with a positive or negative numeric value, with at most 1 decimal.)

[ ] % over the next 12 months

Next

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radius

What do you expect the **average** annual return of the US stock market to be **over the next 10 years**?

Note: This expected return is the change in value, in percent, that you expect to receive **each year on average over the next 10 years** from investing in a portfolio that holds all stocks listed on the US stock market. It includes both dividends and capital gains/losses.

(Please answer only with a positive or negative numeric value, with at most 1 decimal.)

[ ] % per year, over the next 10 years

Next

radius

In this question we present you with five possible scenarios for US stock market returns **over the next 12 months**:

The US stock market return will be...

- Scenario 1: **more than 40%** over the next year.
- Scenario 2: **between 30% and 40%** over the next year.
- Scenario 3: **between -10% and 30%** over the next year.
- Scenario 4: **between -30% and -10%** over the next year.
- Scenario 5: **less than -30%** over the next year.

Please let us know how likely you think it is that each scenario will occur.

Please type in the number to indicate the probability, in percent, that you attach to each scenario. The probabilities of the five scenarios have to sum up to 100%. The graphic bar chart on the right updates automatically to reflect your answers.

(Please answer only with a positive numeric value, with at most 1 decimal.)

more than 40%	[ ] %
between 30% and 40%	[ ] %
between -10% and 30%	[ ] %
between -30% and -10%	[ ] %
less than -30%	[ ] %
Total	0.0%

Remaining probability to fill in: 100.0%

Next

radius

In this question we present you with five possible scenarios for US stock market returns **over the next 12 months**:

The US stock market return will be...

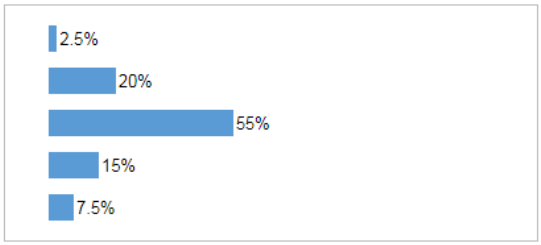
- Scenario 1: **more than 40%** over the next year.
- Scenario 2: **between 30% and 40%** over the next year.
- Scenario 3: **between -10% and 30%** over the next year.
- Scenario 4: **between -30% and -10%** over the next year.
- Scenario 5: **less than -30%** over the next year.

Please let us know how likely you think it is that each scenario will occur.

Please type in the number to indicate the probability, in percent, that you attach to each scenario. The probabilities of the five scenarios have to sum up to 100%. The graphic bar chart on the right updates automatically to reflect your answers.

(Please answer only with a positive numeric value, with at most 1 decimal.)

more than 40%	2.5 %
between 30% and 40%	20 %
between -10% and 30%	55 %
between -30% and -10%	15 %
less than -30%	7.5 %
Total	100.0%



Remaining probability to fill in: 0.0%

Next

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radius

How difficult were the questions about the stock market that you were just asked?

- ○ Not at all difficult
- ○ Not very difficult
- ○ Somewhat difficult
- ○ Very difficult
- ○ Extremely difficult

Next

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GLOBAL MARKET RESEARCH
radius

How confident are you with your answers to the questions about the stock market that you were just asked?

- Extremely confident
- Very confident
- Somewhat confident
- Not very confident
- Not at all confident

Next

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GLOBAL MARKET RESEARCH
radius

In the next questions, we would like to know what you are expecting future economic growth in the US to be.

Again, even if you feel that you are not familiar with the topic, please give us your best prediction.

Next

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radius

What do you expect the **average** annual growth rate of real GDP in the US to be **over the next 3 years**?

Note: Real Gross Domestic Product (GDP) is a measure of economic activity. Real GDP is the total real value of goods and services produced in the US in a year.

(Please answer only with a positive or negative numeric value with at most 1 decimal.)

_____ % per year, over the next 3 years

Next

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radius

What do you expect the **average** annual growth rate of real GDP in the US to be **over the next 10 years**?

Note: Real Gross Domestic Product (GDP) is a measure of economic activity. Real GDP is the total real value of goods and services produced in the US in a year.

(Please answer only with a positive or negative numeric value with at most 1 decimal.)

[ ] % per year, over the next 10 years

Next

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In this question we present you with five possible scenarios for US real GDP **average annual growth rate, over the next 3 years**:

US real GDP average annual growth rate over the next 3 years will be...

- Scenario 1: **more than 9%** per year.
- Scenario 2: **between 3% and 9%** per year.
- Scenario 3: **between 0% and 3%** per year.
- Scenario 4: **between -3% and 0%** per year.
- Scenario 5: **less than -3%** per year.

Please let us know how likely you think it is that each scenario will occur.

Please type in the number to indicate the probability, in percent, that you attach to each scenario. The probabilities of the five scenarios have to sum up to 100%. The graphic bar chart on the right updates automatically to reflect your answers.

(Please answer only with a positive numeric value, with at most 1 decimal.)

more than 9%	[ ] %
between 3% and 9%	[ ] %
between 0% and 3%	[ ] %
between -3% and 0%	[ ] %
less than -3%	[ ] %
Total	0.0%

Remaining probability to fill in: 100.0%

Next

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How difficult were the questions about real GDP growth that you were just asked?

- Not at all difficult
- Not very difficult
- Somewhat difficult
- Very difficult
- Extremely difficult

Next

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How confident are you with your answers to the questions about real GDP growth that you were just asked?

- Extremely confident
- Very confident
- Somewhat confident
- Not very confident
- Not at all confident

Next

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In these final questions, we would like to know what you are expecting future returns on US bonds and future US interest rates to be.

Again, even if you feel that you are not familiar with the topic, please give us your best prediction.

Next

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Suppose that you were to buy a 10-year US Treasury bond today that makes all of its payments at maturity 10 years from now.

Suppose that you were to sell this bond a year from today. What do you expect the return from this bond investment to be **over the next 12 months**?

Note: This expected return is the change in price of the bond that you expect to occur during the next 12 months.

(Please answer only with a positive or negative numeric value with at most 1 decimal.)

[ ]% over the next 12 months

Next

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How difficult were the questions about bonds and interest rates that you were just asked?

- Not at all difficult
- Not very difficult
- Somewhat difficult
- Very difficult
- Extremely difficult

Next

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radius

How confident are you with your answers to the questions about bonds and interest rates that you were just asked?

- Extremely confident
- Very confident
- Somewhat confident
- Not very confident
- Not at all confident

Next

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