

Research Article

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Equity Return Expectations and Financial Wealth Holdings of U.S. Households

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Abstract: This paper examines the association between stock market return expectations and financial wealth holdings of older adults using the 2016 wave of the Health and Retirement Study. Our study finds that less than 30% of individuals assigned a greater than 50% probability that the market will earn a positive nominal return in the following year. However, considerable heterogeneities were observed across racial/ethnic groups. Health status, the cognitive functioning of older adults, and expectations of positive stock market return were positively associated with greater financial wealth holdings among households. Our study also finds that older age, and being female were associated with a higher probability of expected equity returns in the following period. Health status, cognition, and equity return expectations were positively associated with the financial wealth holdings of households. African Americans, Hispanics, and other races were negatively associated with the probability of equity return expectations and financial wealth holdings when compared with the reference group of non-Hispanic Whites. Overall, this study contributes to the literature by applying a unique mathematically derived measure of future return expectations, and extends the literature on equity return expectations and the financial portfolios of households. The negative association between being African American or Hispanic and financial wealth holdings is concerning. The findings from this study inform policy makers, and underscore the need for prioritizing programs and policies that can play a critical role in building human capital, in promoting financial capability, and in bridging the financial wealth gap for households belonging to the disadvantaged and underserved racial ethnic groups.

Keywords: Market Expectations; Cognitive Ability; Positive Nominal Return; Financial Wealth.

1 Introduction

The Expected return of a portfolio plays an important role in portfolio theory (Markowitz, 1991). However, the literature on investment decisions made based on households' future market expectations is relatively new (Glaser & Weber, 2005; Hoffmann et al., 2013; Shiller, 2000). The aim of this study is to examine whether differences in expected future returns can explain some of the disparity in financial wealth holdings among different sociodemographic groups. Findings from the Haliassos and Bertaut (1995) study indicate that although the riskier asset classes have historically outperformed riskless assets such as the U.S. Treasury bill; a substantial portion of the households do not hold any risky assets within their portfolio. The significantly lower allocation of a portfolio into riskier assets by households (Pak & Chatterjee, 2016; Shin & Kim, 2018) is also contrary to the expectations of predictive models based on utility maximization theory (Arrow, 1965; Samuelson, 1969).

Normative financial advice suggests that individuals reduce their allocation in equity-based asset classes with age and with a reduction in their work-life expectancy (Ameriks & Zeldes, 2004; Fan & Chatterjee, 2019). However, this advice is contrary to seminal studies' findings, which suggest that an optimally allocated portfolio does not need to vary over time (Merton, 1969; Samuelson, 1969). Although, it is possible that as individuals age, they become more risk-

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averse, and with increasing risk-aversion, the optimal household portfolio, therefore, becomes less risk-seeking over time (Addoum, 2017; Ameriks & Zeldes, 2004; Fan & Chatterjee, 2019). Still, previous studies have found substantial differences in financial wealth holdings among households (Curcuro et al., 2010; Vissing-Jørgensen, 2002; Fisher & Yao, 2017). One possible explanation for lower financial wealth allocation within individual investor portfolios could be due to lower cognitive ability, which increases both transaction and information search costs for individuals (Christelis et al., 2010; Linnainmaa et al., 2016). The purpose of this study is to extend this literature by investigating whether subjective factors such as perceived risk tolerance, and objective factors such as cognition and estimated future return expectations continue to be associated with financial wealth holdings of households when controlling for other sociodemographic, income, and health-related factors.

The theoretical contribution of this study is the application of a mathematically derived measure of future expected returns, fitted within the context of a rational expectations framework, for examining the association between financial market expectations and financial wealth holdings within household portfolios. Furthermore, this study examines whether differences in perceived risk tolerance, and cognitive ability are associated with individuals' stock market return expectations, and financial asset allocation decisions. From a practical contributions perspective, the key findings from this study aim to shed light on the roles of a number of perceived and objective behavioral factors that may play a role in portfolio management and asset allocation decisions of households, and help in explaining some of the disparities in financial wealth holdings after controlling for a number of different sociodemographic factors.

2 Theoretical Framework

The rational expectations framework posits that households have a rational and unbiased expectation of the future. Previous studies have examined this using households' revealed preferences from their past stock holdings and future stock market expectations (Arthur, 2006; Dominitz & Manski, 2007; Hurd, 2009). D'Acunto et al. (2019) found in their study that cognition was positively associated with rational expectations among individuals. Similarly, other studies have found that lower cognitive ability is associated with miscalibration of inflation expectation among individuals (Bordalo et al., 2018; Coibion et al., 2018); and although access to full information and the ability to synthesize information are associated with rational expectations, information constrained individuals and individuals who do not have the ability to process sophisticated financial information are more likely to mis-calibrate expected future economic outcomes (Coibion & Gorodnichenko, 2015). In this study, we apply the rational expectations framework by examining the association between future market expectations, and the amount of financial wealth held by households when controlling for factors such as risk tolerance, and cognition. Furthermore, we explore the associations conditioned by differences in sociodemographic factors such as marital status, gender, and race/ethnicity.

3 Methodology

3.1 Data

This study uses the 2016 wave of the core Health and Retirement Study (HRS) dataset. The HRS is a nationally representative dataset of Americans aged 50 or older. The dataset is maintained by the University of Michigan and is funded by the Social Security Administration (SSA), the National Institute of Health (NIH), and the National Institute of Aging (NIA). The dataset includes extensive information on respondents' sociodemographic characteristics, household asset and portfolio holdings, and behavioral factors such as perceived risk tolerance and cognition. The HRS dataset oversamples minorities (Health and Retirement Study, 2017).

3.2 Dependent Variables

The first dependent variable used in this study is obtained from responses to the following question:

“By next year at this time, what is the percentage chance that mutual fund shares invested in blue-chip stocks like those in the Dow Jones Industrial Average will be worth more than they are today?”

The responses obtained for this question reveal the individuals’ subjective distribution of expected positive nominal return (PNR).

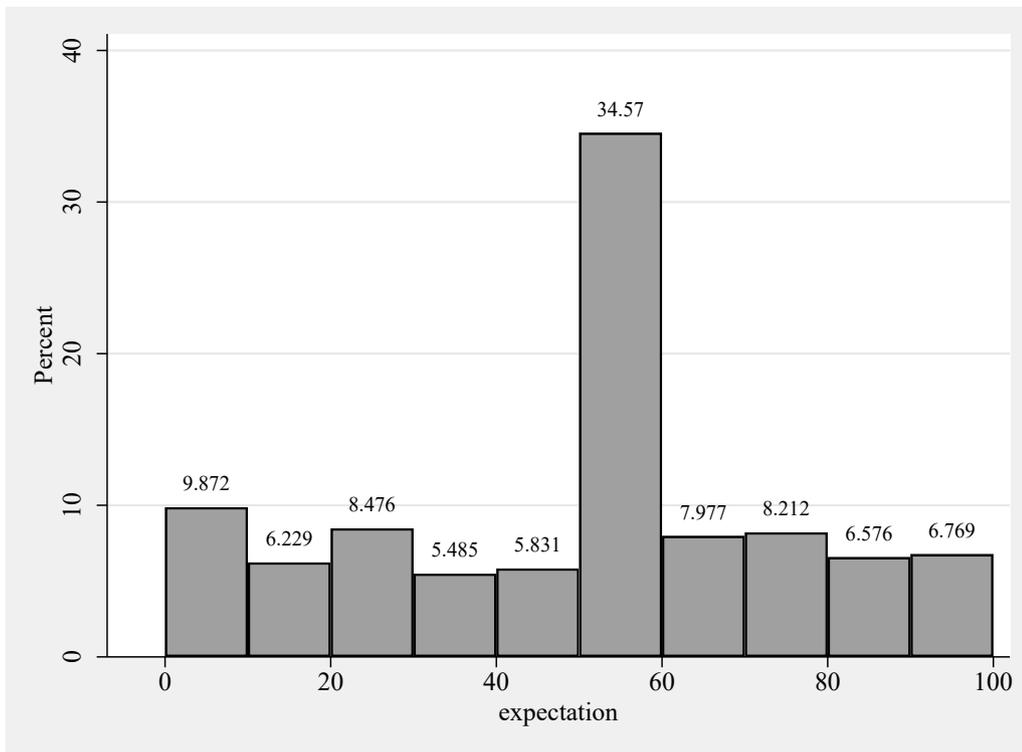


Figure 1: Subjective Distribution of Expected PNR in the overall sample.

The figure 1 results show that majority of the respondents (34.57%) assigned a 50-50 chance of expected PNR in the following year. Less than 30% assigned greater than 50% probability of PNR in the following year. Figure 2 shows the expected probabilities of PNR by gender, marital status, race, and ethnicity. The results indicate that Hispanic respondents assigned lower than average probability of expected PNR. Overall the males and married respondents also assigned lower than average probabilities for expected PNR in the following year.

3.3 Estimating Subjective Mean Returns for the Expected Probabilities of PNR

Previous studies have assumed that people have subjective normal distributions for financial market returns (Merton, 1969; Samuelson, 1969). This assumption is maintained in the current study. Additionally, using the variance of the normal distribution, the expected probabilities of positive stock market return (nominal) can be mathematically transformed to expected mean equity returns. The Modern Portfolio theory suggests that risk averse individuals will allocate into a risky asset within the portfolio only if the expected mean return of the portfolio exceeds the return of the risk-free asset (Markowitz, 1991). We, therefore, follow the method suggested in Manski (2004) and Dominitz and Manski (2007) and assume that r is the expected nominal equity return for the next year, i is an individual participating

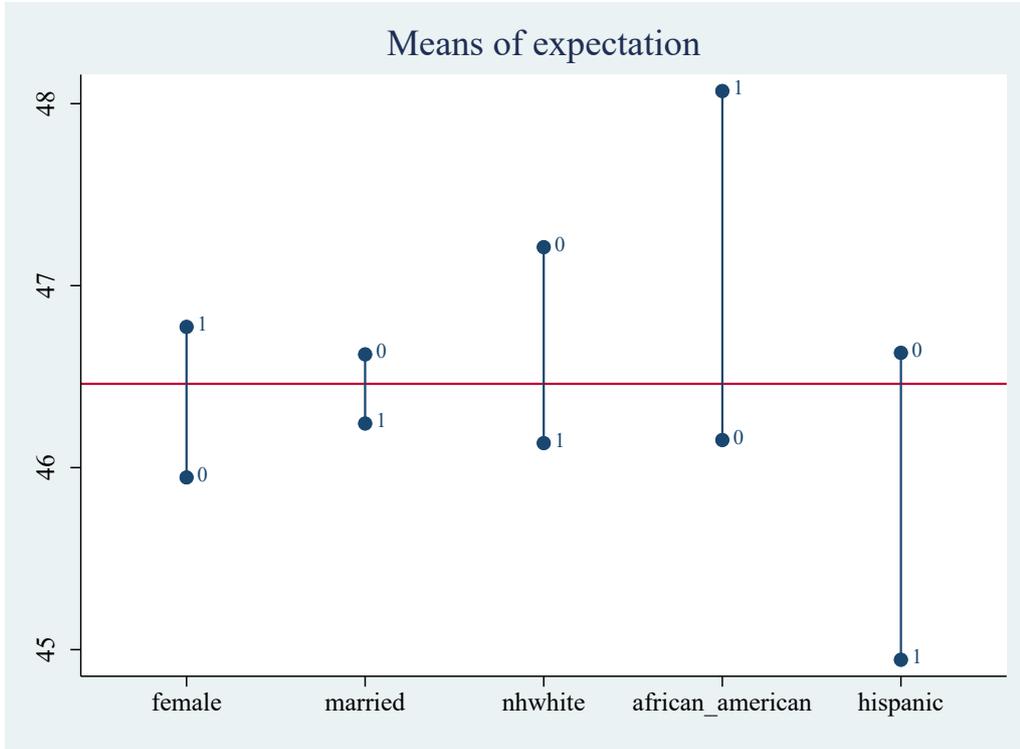


Figure 2: Probabilities of expected PNR by Gender, Marital status, Race and Ethnicity.

in the survey, and P_i is the individual's distribution of expected r . Furthermore, PNR is the individual's subjective probability of expected positive nominal return (PNR) in the next year divided by 100. We assume that P_i is a normal distribution for all i respondents with mean μ_i and variance σ_i^2 . Individuals' responses to the probability of expected PNR can therefore reveal the mean of subjective distribution for the expected return r . We use the following equations for cumulative standard normal distribution (Hogg et al., 2005) to obtain the expected mean:

$$PNR = p_i(r > 0) = \frac{p_i(r - \mu_i)}{\sigma_i} > -\frac{\mu_i}{\sigma_i} = 1 - \phi\left(-\frac{\mu_i}{\sigma_i}\right) \quad (1)$$

Where, $u_i = -\sigma_i * \phi^{-1}(1 - q_i)$ and, $\phi =$ Cumulative normal distribution function.

The mean nominal annual equity returns (including dividend re-investment), during 1928-2020 are computed to be 11.64%, and the standard deviation is 19.49% (Damodaran, 2021). This historic standard deviation value of 0.1949 can be substituted for standard deviation (σ_i) in our model, and its z-scores can be used to find the mean return. For example, when PNR=0.60, the mean μ_i is 0.049; for PNR=0.70, the mean $\mu_i=0.102$; for PNR=0.75, the mean $\mu_i=0.1315$, and so on.

When examining the extensive margins of whether an individual is likely to choose a risky asset in an optimal portfolio, if all individuals are assumed to have access to the same risk-free rate and expected uncertainty σ for the stock returns, then the probability of holding a risky asset will increase with the expected subjective probability of PNR. Our study examines this association after controlling for factors such as cognitive functioning, and individuals' subjective risk tolerance.

3.4 Cognitive Functioning

Prior research has found that cognitive functions deteriorate as people age, which can negatively impact the retirement security of the households (Agarwal et al., 2009; Schroeder & Salthouse, 2004). Other studies have found that poor cognitive functioning can also undermine peoples' financial management abilities (Bogan & Fertig, 2013; Van Rooij

et al., 2011). The 2016 HRS dataset provides cognition scores for individuals. To control for the negative effect of deteriorating cognitive functioning on peoples' financial expectations, we control for this variable in our model.

3.5 Perceived Risk Tolerance

Previous research has found perceived risk tolerance to be associated with financial decision-making (Schubert et al., 1999). The HRS includes a measure of perceived risk tolerance:

“Please rate yourself from 0 to 10, where 0 means ‘not at all willing to take risks’ and 10 means ‘very willing to take risks?’”

We include this variable as a control in our model.

3.6 Other Variables

Several other sociodemographic variables such as age, gender, race/ethnicity, marital status, household income, educational attainment, and self-reported health status are also included in our estimation model.

3.7 Empirical Models

Since our first dependent variable expected probability percentage of PNR ranges from 0-1, we use a double censored (censored below 0 and above 1) tobit specification for the first part of this study. Given the double censored nature of our dependent variable, a tobit estimation model, which uses maximum likelihood estimation, produces consistent estimates for α and β (Tobin, 1958; Wooldridge, 2010).

$$Y_i = \alpha + \beta_1 Cog_i^* + \beta_2 Risk_i^* + \beta_3 X_i^* + \varepsilon_i^* \quad (2)$$

Where $Y_i = Y_i^*$ for $Y_i^* < 1$ and $Y_i^* = 1$ for $Y_i^* \geq 1$

The actual estimated equation then becomes:

$$Y_i = \alpha + \beta_1 Cog_i + \beta_2 Risk_i + \beta_3 X_i + \varepsilon_i \quad (3)$$

For the second analysis of this study, log (Financial Wealth) is regressed against the probability of expected PNR after controlling for other factors included in equation three above. Since the financial wealth variable is continuous, we use Ordinary Least Squares (OLS) regression for our analysis:

$$Y_i = \alpha + \beta_1 Prob_PNR_i + \beta_2 Cog_i + \beta_3 Risk_i + \beta_4 X_i + \varepsilon_i \quad (4)$$

Y_i = Probability percentage of expected PNR; Cog_i =Cognition score; $Risk_i$ =Perceived risk; X_i =Vector of other control variables included in the model.

4 Results

The descriptive statistics are presented below in table 1. The mean probability of expected PNR was 0.465 (SD=0.262). The average age of the sample was 76. In this study, 56% were females, and non-Hispanic whites comprised 65% of the sample. In this sample, 27% were married, and 19% had educational attainment of college or higher. The average household income was \$74,248, average financial wealth was \$116,627, and average total wealth was \$438,911.

Table 1: Descriptive Statistics.

Variables	Mean	SD	Min	Max
Exp PNR	0.465	0.261	0.000	1.000
Age	76.443	15.944	50.000	126.000
Female	0.561	0.496	0.000	1.000
<i>Race/Ethnicity</i>				
NH White	0.653	0.476	0.000	1.000
African American	0.187	0.390	0.000	1.000
Hispanic	0.123	0.329	0.000	1.000
Other Race	0.043	0.277	0.000	1.000
Married	0.271	0.444	0.000	1.000
<i>Educational Attainment</i>				
<High School	0.254	0.436	0.000	1.000
High School	0.330	0.470	0.000	1.000
Some Col.	0.223	0.416	0.000	1.000
Coll or More	0.192	0.394	0.000	1.000
<i>Health Status</i>	2.048	1.066	0.000	4.000
<i>Risk Tolerance</i>	5.794	2.736	0.000	10.000
<i>Cognition</i>	9.645	3.545	0.000	20.000
HH Income	\$ 74,248.38	\$ 131,120.40	\$ -	\$ 7,795,036.00
Fin Wealth	\$ 116,626.70	\$ 531,806.60	\$ (1,800,000.00)	\$ 16,200,000.00
Total Wealth	\$ 438,910.60	\$ 1,110,546.00	\$ (1,098,000.00)	\$ 26,200,000.00

4.1 Factors Associated with the Probability of Expecting PNR

Table 2 shows the tobit estimation of the probability of expecting PNR. The results indicate that age-squared ($\beta=0.125$; $p<0.001$), and women ($\beta=16.851$; $p<0.001$) were positively associated with the probability of expecting PNR. Conversely, the results also indicate that age ($\beta=-8.803$; $p<0.01$) was negatively associated with the probability of expecting PNR; African American ($\beta=-14.087$; $p<0.001$), Hispanic ($\beta=-10.503$; $p<0.001$) and other minority racial-ethnic groups ($\beta=-12.979$; $p<0.001$), when compared with non-Hispanic whites, were also negatively associated with the probability of expecting PNR.

4.2 Association between Probability of Expecting PNR and Financial Wealth Holdings

This study further explores whether the probability of expected PNR was associated with the log-transformed value of financial wealth holdings. The results shown in table 3 indicate a positive association between the probability of expecting PNR ($\beta=0.005$; $p<0.01$) and financial wealth. Among other control variables, being married ($\beta=0.786$; $p<0.001$), educational attainment of college or higher ($\beta=1.834$; $p<0.001$), health status ($\beta=0.809$; $p<0.001$), cognitive functioning ($\beta=0.100$; $p<0.001$), and income ($\beta=0.446$; $p<0.001$) were positively associated with financial wealth holdings of households. Conversely, women ($\beta=-0.335$; $p<0.001$), African American ($\beta=-2.816$; $p<0.001$), and Hispanic ($\beta=-2.776$; $p<0.001$) households were negatively associated with the financial wealth holdings of households.

Table 2: Tobit: Probability of expected PNR.

Dep Var: Prob. Exp PNR	Coef.	SE	Sig	95% Conf. Interval	
Age	-8.803	3.982	**	-16.609	-0.997
Age Square	0.125	0.030	***	0.067	0.184
Female	16.851	2.083	***	12.767	20.936
African American	-14.087	2.482	***	-18.952	-9.221
Hispanic	-10.503	3.372	***	-17.112	-3.893
Otherrace	-12.979	4.139	***	-21.093	-4.865
Married	3.765	2.096		-0.344	7.874
Coll or More	-4.486	2.352		-9.096	0.125
Health Status	-0.019	0.958		-1.898	1.860
Risk Tolerance	0.226	0.343		-0.447	0.899
Cognition	-0.209	0.312		-0.821	0.402
L(HH Income)	1.142	0.711		-0.251	2.535
Intercept	-23.197	132.355		-282.655	236.260

Pseudo R-Squared=0.1558
LR Chi-squared=2743.23 p<0.000
N=6804

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

5 Discussions and Conclusion

The significant findings from table 2 are summarized in table 4. The positive association between age-squared and expected PNR suggests that older adults assigned a higher probability of expecting PNR for the next year. This result can be interpreted to indicate that positive expectation in market's returns increases with age. Perhaps, people start trusting the economy and the financial systems more as their experience with investing increases with their participation in the financial markets over time. In a previous study, Hansen et al. (2008) found that older adults (above 67) were more content financially in their life when compared to younger households. It is possible that older adults have a positive outlook of the future, and hence have a positive association with expecting PNR for the following year. This is a new contribution to the literature, as to our knowledge, no previous studies have examined the association between age and PNR expectation. More research is needed in the future to examine whether the associations found in this study hold true across time.

More research is also needed to understand the positive association between female and expected PNR. This finding suggests that women had more favorable expectations of financial market's performance than men, during the period of this study. However, most previous studies indicate that women have lower financial confidence and hold more conservative and lower risk investment portfolios (Butcher Koenen et al., 2021; Hurd et al., 2011). Other studies have indicated that women have lower financial literacy than men. Therefore, it is possible that women mis-calibrated expected PNR when compared with men. One limitation of this study was that our model did not include a measure of financial literacy. Future studies can control for financial literacy to examine whether this association between women and expected PNR remains consistently positive.

After controlling for other factors in the tobit, model the African American, Hispanic, and other minority respondents were negatively associated with the probability of expecting PNR. The negative associations between minority racial-ethnic groups and the probability of expecting PNR corroborate with the findings from previous studies, which find a negative association between minority racial-ethnic groups and investment in risky asset portfolios (Christelis et

Table 3: OLS: Financial Wealth Holdings and Prob. Exp PNR.

Variables	Coef.	Robust SE	Sig	95% Conf. Interval	
Exp PNR	0.005	0.003	**	0.000	0.010
Age	-0.027	0.103		-0.229	0.175
Age Square	0.001	0.001		-0.001	0.003
Female	-0.335	0.111	***	-0.553	-0.118
African American	-2.816	0.132	***	-3.075	-2.557
Hispanic	-2.776	0.174	***	-3.117	-2.436
Otherrace	-0.103	0.191		-0.477	0.271
Married	0.786	0.116	***	0.558	1.013
Coll or More	1.834	0.136	***	1.567	2.100
Health Status	0.809	0.052	***	0.706	0.912
Risk Tolerance	-0.002	0.019		-0.039	0.036
Cognition	0.100	0.017	***	0.066	0.134
L(HH Income)	0.446	0.027	***	0.393	0.498
Intercept	-3.429	3.227		-9.756	2.897
R-Squared=0.3557					
F-Stat: 304.40; p<0.000					
N=6804					

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 4: Direction of the significant association with p (PNR).

Variables	Direction
Age	-
Age Square	+
Female	+
Non-white	-

Table 5: Direction of the significant associations with log-transformed financial wealth.

Variables	Direction
Exp PNR	+
Female	-
African American	-
Hispanic	-
Married	+
Coll or More	+
Health Status	+
Cognition	+
L(HH Income)	+

al., 2011; Hanna & Lindamood, 2008; Kim et al., 2012). The findings from this study add to the literature in this area, and indicates that minority households have a pessimistic expectation of PNR, which may be translating into lower participation rates in the financial market participation, and hence lower probability of accumulating financial wealth across time, among the minority racial-ethnic groups.

The significant findings from the second analysis are summarized in table 5. We found that the probability of expecting positive PNR was positively associated with financial wealth holdings among households. This finding is

consistent with the findings from the previous study by Dominitz and Manski (2007). Dominitz and Manski (2007) found a positive association between the percentage of stock holdings within a household's portfolio and the probability of expecting PNR. In another study, Arrondel et al. (2014) found a positive association between the probability of expecting PNR and stock holdings within a household's portfolio among respondents in France.

The direction and significance of the other control variables and financial wealth holdings of households are consistent with findings from past literature (Friedberg & Webb, 2006; Poterba et al., 2018). From a policy perspective, the negative association between being African American or Hispanic and the probability of expecting PNR is concerning. It is also concerning that both African American households and Hispanic households were negatively associated with financial wealth holdings. The findings of this study underscore the importance of promoting policies aimed at improving educational attainment, health status, and income of minority households, for bridging the financial wealth gap found in the current study.

This study was constrained by several limitations. The model can be further expanded in the future to include financial literacy-related factors. Also, since this study was done using a cross-sectional wave of the HRS. In future studies, examining the time-varying factors across time, and with more recently available data, might be insightful for developing a better understanding of the causal relationships and heterogeneities.

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References

- Addoum, J. M. (2017). Household portfolio choice and retirement. *Review of Economics and Statistics*, 99(5), 870-883.
- Agarwal, S., Driscoll, J. C., Gabaix, X., & Laibson, D. (2009). The age of reason: Financial decisions over the life cycle and implications for regulation. *Brookings Papers on Economic Activity*, 2009(2), 51-117.
- Ameriks, J., & Zeldes, S. P. (2004). *How do household portfolio shares vary with age* (pp. 1-87). working paper, Columbia University.
- Arrondel, L., Calvo Pardo, H. F., & Tas, D. (2014). Subjective return expectations, information and stock market participation: evidence from France. *Information and Stock Market Participation: Evidence from France (March 14, 2014)*.
- Arrow, K. J. (1965). Uncertainty and the welfare economics of medical care: reply (the implications of transaction costs and adjustment lags). *The American economic review*, 55(1/2), 154-158.
- Arthur, W. B. (2006). Out-of-equilibrium economics and agent-based modeling. *Handbook of Computational Economics*, 2, 1551-1564.
- Bogan, V. L., & Fertig, A. R. (2013). Portfolio choice and mental health. *Review of Finance*, 17(3), 955-992.
- Bucher-Koenen, T., Alessie, R. J., Lusardi, A., & Van Rooij, M. (2021). *Fearless woman: Financial literacy and stock market participation* (No. w28723). National Bureau of Economic Research.
- Chatterjee, S., Fan, L., Jacobs, B., & Haas, R. (2017). Risk tolerance and goals-based savings behavior of households: The role of financial literacy. *Journal of Personal Finance*, 16 (1), 66-77.
- Christelis, D., Jappelli, T., & Padula, M. (2010). Cognitive abilities and portfolio choice. *European Economic Review*, 54(1), 18-38.
- Christelis, D., Georgarakos, D., & Haliassos, M. (2011). Stockholding: Participation, location, and spillovers. *Journal of Banking & Finance*, 35(8), 1918-1930.
- Coibion, O., & Gorodnichenko, Y. (2015). Information rigidity and the expectations formation process: A simple framework and new facts. *American Economic Review*, 105(8), 2644-78.
- Coibion, O., Gorodnichenko, Y., & Kamdar, R. (2018). The formation of expectations, inflation, and the phillips curve. *Journal of Economic Literature*, 56(4), 1447-91.
- Curcuro, S., Heaton, J., Lucas, D., & Moore, D. (2010). Heterogeneity and portfolio choice: Theory and evidence. In *Handbook of financial econometrics: Tools and techniques* (pp. 337-382). North-Holland.
- D'Acunto, F., Hoang, D., Paloviita, M., & Weber, M. (2019). *IQ, expectations, and choice* (No. w25496). National Bureau of Economic Research.
- Damodaran, A. (2021, January). Historic Returns on Stocks, Bonds, and Bills: 1928-2020. http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/histretSP.html
- Dominitz, J., & Manski, C. F. (2007). Expected equity returns and portfolio choice: Evidence from the Health and Retirement Study. *Journal of the European Economic Association*, 5(2-3), 369-379.
- Fan, L., & Chatterjee, S. (2019). Bequest expectations among the US older adults: The roles of generational differences and personality traits. *Financial Planning Review*, 2(3-4), e1057.
- Fisher, P. J., & Yao, R. (2017). Gender differences in financial risk tolerance. *Journal of Economic Psychology*, 61, 191-202.

- Friedberg, L., & Webb, A. (2006). *Determinants and consequences of bargaining power in households* (No. w12367). National Bureau of Economic Research.
- Glaser, M., & Weber, M. (2005). September 11 and stock return expectations of individual investors. *Review of Finance*, 9(2), 243-279.
- Haliassos, M., & Bertaut, C. C. (1995). Why do so few hold stocks? *The Economic Journal*, 105(432), 1110-1129.
- Hanna, S. D., & Lindamood, S. (2008). The Decrease in Stock Ownership by Minority Households. *Journal of Financial Counseling and Planning Volume*, 19(2), 47.
- Hansen, T., Slagsvold, B., & Moum, T. (2008). Financial satisfaction in old age: A satisfaction paradox or a result of accumulated wealth?. *Social Indicators Research*, 89(2), 323-347.
- Health and Retirement Study (2017). *Growing Older in America*. National Institute of Aging, 1-102. https://www.nia.nih.gov/sites/default/files/2017-06/health_and_retirement_study_0.pdf
- Hogg, R. V., McKean, J., & Craig, A. T. (2005). *Introduction to mathematical statistics*. Pearson Education.
- Hoffmann, A. O., Post, T., & Pennings, J. M. (2013). Individual investor perceptions and behavior during the financial crisis. *Journal of Banking & Finance*, 37(1), 60-74.
- Hurd, M. D. (2009). Subjective probabilities in household surveys. *Annu. Rev. Econ.*, 1(1), 543-562.
- Hurd, M., Van Rooij, M., & Winter, J. (2011). Stock market expectations of Dutch households. *Journal of Applied Econometrics*, 26(3), 416-436.
- Kim, E. J., Hanna, S. D., Chatterjee, S., & Lindamood, S. (2012). Who among the elderly owns stocks? The role of cognitive ability and bequest motive. *Journal of Family and Economic Issues*, 33(3), 338-352.
- Linnainmaa, J. T., Torous, W., & Yae, J. (2016). Reading the tea leaves: Model uncertainty, robust forecasts, and the autocorrelation of analysts' forecast errors. *Journal of Financial Economics*, 122(1), 42-64.
- Manski, C. F. (2004). Measuring expectations. *Econometrica*, 72(5), 1329-1376.
- Markowitz, H. M. (1991). Foundations of portfolio theory. *The Journal of Finance*, 46(2), 469-477.
- Merton, R. C. (1969). Lifetime portfolio selection under uncertainty: The continuous-time case. *The Review of Economics and Statistics*, 247-257.
- Pak, T. Y., & Chatterjee, S. (2016). Aging, overconfidence, and portfolio choice. *Journal of Behavioral and Experimental Finance*, 12, 112-122.
- Poterba, J., Venti, S., & Wise, D. A. (2018). Longitudinal determinants of end-of-life wealth inequality. *Journal of Public Economics*, 162, 78-88.
- Samuelson, P. A. (1969). Presidential Address The Way of an Economist. In *International Economic Relations* (pp. 1-11). Palgrave Macmillan, London.
- Schubert, R., Brown, M., Gysler, M., & Brachinger, H. W. (1999). Financial decision-making: are women really more risk-averse?. *American economic review*, 89(2), 381-385.
- Schroeder, D. H., & Salthouse, T. A. (2004). Age-related effects on cognition between 20 and 50 years of age. *Personality and Individual Differences*, 36(2), 393-404.
- Shiller, R. J. (2000). Measuring bubble expectations and investor confidence. *The Journal of Psychology and Financial Markets*, 1(1), 49-60.
- Shin, S. H., & Kim, K. T. (2018). Income uncertainty and household stock ownership during the great recession. *Journal of Financial Counseling and Planning*, 29(2), 383-395.
- Tobin, J. (1958). Estimation of relationships for limited dependent variables. *Econometrica: journal of the Econometric Society*, 26(1), 24-36.
- Van Rooij, M., Lusardi, A., & Alessie, R. (2011). Financial literacy and stock market participation. *Journal of Financial Economics*, 101(2), 449-472.
- Vissing-Jørgensen, A. (2002). Limited asset market participation and the elasticity of intertemporal substitution. *Journal of Political Economy*, 110(4), 825-853.
- Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.