CHAPTER 30 COGNITIVE ABILITIES AND FINANCIAL DECISIONS

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INTRODUCTION

This chapter focuses on an important but previously unexplored determinant of stock investment decisions, namely, cognitive abilities. At first glance, intelligence should be correlated with success in financial decisions. However, directly establishing this link is difficult because data sets that contain both measures of cognitive abilities and financial performance are hard to obtain. Even with rich data sets, the impact of cognitive abilities on financial decisions may be difficult to quantify because this relation is likely to be complex and multi-faceted. For example, predicting whether the quality of investment decisions would improve or deteriorate with age poses numerous problems. Although older investors would accumulate greater knowledge about the fundamental principles of investing from their investment experience, their declining cognitive abilities could hinder the effective application of those principles. If the adverse effects of aging dominate the positive effects of experience, older investors' portfolios may underperform common performance benchmarks.

Similarly, whether smarter individuals would follow the normative prescriptions of portfolio theory or adopt active investment strategies *ex ante* is not entirely obvious. On the one hand, due to their greater sophistication, they may be more likely to realize that beating the market on a consistent basis would be difficult. Therefore, such individuals would choose a well-diversified portfolio and follow passive buy-and-hold strategies. But on the other hand, due to their higher sophistication levels, they may feel more competent and may also be more likely to adopt active trading strategies to beat various passive performance benchmarks.

For example, investors with higher cognitive abilities may distort their portfolios and hold concentrated portfolios, trade aggressively, or over-weight local stocks. Further, these portfolio distortions would have a positive impact on realized portfolio performance. In contrast, when individuals with lower cognitive abilities follow these types of portfolio distortions, they may not succeed and earn lower average performance. Therefore, by conditioning on the level of cognitive abilities, the possibility exists to better quantify the performance effects of deviations from the normative prescriptions of portfolio theory.

In spite of these difficulties, a growing literature in behavioral finance has taken up the challenge and has attempted to establish the link between intelligence and portfolio decisions. The chapter begins with a review of the literature that studies the link between cognitive abilities and broad financial decisions (e.g., stock market participation). The next section examines the impact of investor intelligence on portfolio decisions following an individual's decision to participate in the stock market. Two themes are highlighted. First explored is whether older investors make worse investment decisions due to the adverse effects of cognitive aging. Second, the effects of cognitive abilities on portfolio performance are summarized when investors do not follow the normative prescriptions of portfolio theory and distort their portfolios. In this section of the chapter, an empirical model of cognitive abilities is outlined that links various demographic characteristics to abilities. In the last section, the growing literature that examines the role of cognitive abilities in other financial settings is reviewed.

COGNITIVE ABILITIES AND BROAD FINANCIAL DECISIONS

Several recent studies show that the level of cognitive abilities affects the stock market participation decision, broad economic decisions, and financial decisions. The data sets used in these studies do not contain detailed information on the assets held in households' financial portfolios. Instead, they only provide aggregate measures of household wealth and overall portfolio positions in riskless and risky assets.

Benjamin, Brown, and Shapiro (2006) collect data from the National Longitudinal Survey of Youth 1979 (NLSY). After 1980, most NLSY respondents are administered the Armed Services Vocational Aptitude Battery (ASVAB) of tests. Based on their performance on the ASVAB tests, each respondent is assigned a percentile score, which represents their level of cognitive ability. The NLSY also includes two questions related to financial decisions. To assess the level of asset accumulation, the respondents are asked whether their net worth is negative, zero, or positive. Excluding retirement accounts, the respondents are also asked whether they directly hold financial assets. After controlling for income and family background, Benjamin et al. find a strong relationship between cognitive abilities and the likelihood of accumulating positive net assets. They also report that smart respondents tend to participate more in the stock market.

Kezdi and Willis (2003) use the 1992-2000 waves of the Health and Retirement Survey (HRS) in the United States to examine stock market participation. As part of their analysis, they calculate cognitive ability indices for the HRS households and include them in the participation regressions. They divide their cognitive indices into four groups: intellectual ability (IQ), memory (based on word recall), numeracy (based on counting back by sevens), and dementia (based on the interview questions). The Telephone Interview of Cognitive Status (TICS) battery includes questions such as naming the President and Vice-President of the United States. Their analysis shows that households with high IQ scores participate more in the stock market. Among the households not participating in the stock market at the beginning of the sample, the probability of becoming a stockholder by the end of the sample is higher for smarter investors. Further, conditional upon owning stocks at the beginning of the sample, the probability of exiting the stock market is lower for smarter investors.

McArdel, Smith, and Willis (2009) also use data from the HRS. Following the psychology literature, they also combine various questions and construct indices measuring numeracy, memory recall, verbal fluency, and mental status. Similar to Kezdi and Willis (2003), the mental

status questions are from the TICS. The authors show that total wealth, total financial wealth, and the fraction of financial wealth held in equity rise with the numeracy score of the respondent. For example, achieving the highest score on the numeracy index is associated with a $20,000 increase in total household wealth and about a $7,000 increase in financial wealth. They also find that households with high memory recall scores accumulate more total wealth and financial wealth.

In a recent study, Stango and Zinman (2008) focus on a particular form of numerical cognitive impairment, namely, the exponential growth bias. This bias refers to the tendency of individuals to systematically underestimate the growth or decline of exponential series when making calculation without the help of a calculator. To measure the bias, they use two questions from the 1987 Survey of Consumer Finances (SCF), which ask respondents about the repayment total of a hypothetical loan and perceived annual percentage rate of the same loan. Stango and Zinman find that the relationship between the exponential growth bias and the proportion of assets held in stocks is negative. In particular, their results imply that the bias induces about an 18 to 55 percent decrease in stock holdings. They also show that more biased households tend to borrow more and save less. Taken together, the studies that use U.S. household-level data find a strong correlation between cognitive abilities and stock market participation decision.

Christelis, Jappelli, and Padula (2008) report similar results using data from the Survey of Health, Aging, and Retirement in Europe (SHARE), which surveys people aged 50 and older in 11 European countries. Apart from demographic and financial information, the survey includes a complete and accurate set of cognitive ability indicators measuring verbal fluency, numeracy, and memory recall. Christelis et al. find that cognitive abilities are highly correlated with direct stock market participation and total stock market participation, which includes mutual fund holdings and managed investment account. Conditional on the known determinants of stock market participation (e.g., age, health, marital status, income, wealth, and social

activities), they report that a one standard deviation increase in numeracy, verbal fluency, and memory recall, increases total stock market participation by 1.8 percent, 1.7 percent, and 1.3 percent, respectively. Overall, these studies demonstrate that cognitive abilities influence the decision to participate in the stock market.

DO OLDER INVESTORS MAKE BETTER INVESTMENT DECISIONS?

Due to limited data availability, few studies examine the impact of cognitive abilities after a household enters the stock market. In this section and following sections, two studies are summarized. In the first paper, Korniotis and Kumar (2009) investigate the investment decisions of older investors and interpret them within the framework of cognitive aging. In the second paper, Korniotis and Kumar (2008) test whether a relationship exists between cognitive abilities and three puzzling results reported in the recent literature on retail investors.

Evidence from Psychology

Korniotis and Kumar (2009) are motivated by psychological evidence, which indicates that both physical and cognitive abilities, especially memory, decline with age (e.g., Horn, 1968; Salthouse, 2000; Schroeder and Salthouse, 2004). Weakening memory slows down the information processing ability of individuals and leads to a decline in older people's ability to perceive conditional probabilities (Spaniol and Bayen, 2005). Additionally, due to a decline in attentional ability, older people get distracted easily and are unable to distinguish between relevant and irrelevant information.

The psychological evidence also indicates that people are likely to experience a decline in the level of their general intelligence as they grow older. The aging process influences general intelligence through two distinct channels. First, the general intelligence level declines with age due to the negative impact of aging on memory and attention (e.g., Lindenberger and Baltes, 1994; Baltes and Lindenberger, 1997). Second, the sensory (vision and hearing) functioning worsens with age and is associated with lower levels of intelligence. The decline in

intelligence is much steeper after the age of 70 (Lindenberger and Baltes, 1997), while these adverse effects are attenuated in people's area of expertise due to frequent practicing (Masunaga and Horn, 2001).

In addition to biological and psychological factors, socioeconomic and demographic factors such as education, income, wealth, race, ethnicity, and gender can exacerbate the adverse effects of cognitive aging. For example, people who are more educated, more resourceful (i.e., have higher income and are wealthier), and undertake intellectually stimulating jobs experience a slower decline in cognitive abilities because they are able to actively compensate for the adverse effects of aging (Baltes and Lang, 1997; Cagney and Lauderdale, 2002). In contrast, the age-related decline in cognitive abilities is steeper among older women (Shanan and Sagiv, 1982) as well as older African Americans and Hispanics (Black, 2004).

Overall, the evidence from research in psychology suggests that older people would react to new information inappropriately because they are typically slower and less effective at processing and integrating new information. As a result, old age is likely to have an adverse effect on people's ability to make effective investment decisions.

In addition to the negative channel of cognitive aging, a positive channel of experience may induce older investors to make better investment decisions. Specifically, older investors are likely to have greater investment experience and greater awareness of the fundamental principles of investing than younger investors. Their accumulated investing wisdom could help them make more efficient investment decisions. This last conjecture is motivated by the extant empirical evidence from the individual investor literature, which indicates that older investors exhibit a weaker disposition effect (Dhar and Zhu, 2006), hold less concentrated portfolios (Goetzmann and Kumar, 2008), and exhibit a lower degree of over-confidence (Barber and Odean, 2001). Furthermore, these behavioral biases decline as investors learn and gain more experience (e.g., List, 2003; Feng and Seasholes, 2005). Older investors are also less prone to gambling type activities in the stock market (Kumar, 2009). Taken together, the evidence from

the cognitive aging and learning research indicates that aging and learning processes operate simultaneously.

Testable Hypothesis and Data Description

Motivated by this evidence, Korniotis and Kumar (2009) conjecture that older investors would accumulate greater knowledge about the fundamental principles of investing because of their greater investment experience. However, their declining cognitive abilities would hinder the effective application of those principles. If the adverse effects of aging dominate the positive effects of experience, older investors' portfolios would underperform common performance benchmarks.

Using the end-of-month portfolio holdings and trades of a sample of individual investors at a large U.S. brokerage house, Korniotis and Kumar (2009) empirically test this dual pronged conjecture. The time period of their sample is from 1991 to 1996. There are 77,995 households in the retail database who hold common stocks and trade other securities such as mutual funds, options, and American depository receipts (ADRs). Their study focuses on the investment behavior of 62,387 investors who have traded common stocks. For a subset of households, demographic information such as age, income, wealth, occupation, marital status, and gender is available. The demographic measures such as age, income, marital status, and family size are compiled by Infobase Inc. a few months after the end of the sample period (June 1997). Further details on the investor database are available in Barber and Odean (2000).

Positive Effects of Investment Experience

Korniotis and Kumar (2009) first examine whether older investors possess greater knowledge about investing. Specifically, they focus on several important dimensions of portfolio decisions that reflect common investment "rules of thumb". To begin, they examine whether older investors are more likely to recognize the potential benefits of diversification. Next, the authors examine whether older investors trade less frequently because they realize their

inability to improve performance through active trading. Last, they examine whether older investors are more likely to engage in year-end tax-loss selling, since it requires financial awareness but does not necessarily require skill.

In their first set of results, Korniotis and Kumar (2009) use the number of stocks held by an investor to proxy whether older investors are more aware of the potential benefits of diversification. They find that older and more experienced investors hold portfolios containing a greater number of stocks. In particular, both age and investment experience are significant predictors of the number of stocks held, even in the presence of various control variables.

Next, Korniotis and Kumar (2009) examine whether older investors engage in active trading. They measure trading activity with monthly portfolio turnover rates. In the analysis, the authors find that age and experience are significantly negatively correlated with turnover rates. This evidence indicates that the trading behavior of older investors is more likely to conform to another key principle of investing, namely, less frequent trading.

Finally, Korniotis and Kumar (2009) test whether older investors exhibit a greater propensity to engage in year-end tax-loss selling. Specifically, they examine the relationship between age and the proportion of "losers" (stock investments in which an investor suffers a loss) sold in the month of December. Their analysis indicates that both older and more experienced investors are more willing to sell their losers in December.

Adverse Effects of Cognitive Aging

While older investors, especially those who are more experienced, exhibit a greater propensity to follow common investment rules of thumb, how effectively can they apply those principles? To answer this question, Korniotis and Kumar (2009) study the relation between age, investment experience, and investment skill.

Figure 30.1 shows the univariate relation between age and investment skill, as captured by the Daniel, Grinblatt, Titman, and Wermers (1997) characteristic-adjusted performance

measure. The figure includes both the average portfolio return and the return differential between the first and second halves of the sample period. Two features of the plot are noteworthy. First, the investment performance exhibits an inverted U-shape with a peak at around 42 years. The hump shape reflects the combined effects of experience and aging. This evidence is consistent with the findings in Agarwal, Driscoll, Gabaix, and Laibson (2009), who uncover a similar pattern in the borrowing rates of households in various credit markets.

Second, there is an abrupt and significant drop in investment performance around the age of 70. This nonlinear effect is consistent with the evidence from studies in psychology that document a steeper cognitive decline after the age of 70. Overall, the graphical evidence reveals that the negative effects of aging have a dramatic impact on the performance of older and more experienced investors.

(Insert Figure 30.1 about here)

Korniotis and Kumar (2009) further explore the impact of age and experience on performance by estimating "skill" regressions. In these cross-sectional regressions, a measure of investment skill is employed as the dependent variable. The authors focus on two investment skill measures: "diversification skill" (captured by monthly portfolio Sharpe ratios) and stock selection ability (captured by monthly portfolio alphas). Their conjecture is that although older investors hold portfolios with larger number of stocks, they might not possess "diversification skill" because the ability to perceive correlations accurately would decline with age. Furthermore, investors' stock selection skill could decline with age because the adverse effects of cognitive aging would influence people's ability to efficiently process new information. In contrast, both diversification skill and stock selection abilities would improve with investment experience.

The results of the skill regressions confirm that, conditional on various control variables (including investment experience), age has a negative effect on investment skill. Moreover, the regression estimates indicate that, all else equal, a one standard deviation shift in the age of an

investor who does not belong either to the low (bottom quintile) income, low education (bottom quintile), or ethnic minority groups would be associated with an annual, risk-adjusted performance decline of 0.61 percent. This indicates that when an investor aged 30 becomes older and crosses the retirement age of 65 (a three standard deviation change in age), she is likely to suffer an annual performance decline of 1.84 percent on a risk-adjusted basis.

Overall, the skill regression estimates indicate that investment skill increases with experience due to the positive effects of learning, but declines with age due to the adverse effects of cognitive aging. This decline in skill is steeper among less educated and less wealthy older investors who belong to minority groups.

COGNITIVE ABILITIES, PORTFOLIO DISTORTIONS, AND PERFORMANCE

In the second paper, Korniotis and Kumar (2008) test if cognitive abilities are related to three puzzling results established in the recent literature on retail investors. The first puzzling finding is that, contrary to the normative prescriptions of traditional portfolio theory, retail investors hold concentrated portfolios with only a few stocks (e.g., Barber and Odean, 2000). Whether certain investors hold few stocks because they are relatively unsophisticated and exhibit stronger behavioral biases is not entirely clear (Goetzmann and Kumar, 2008). Nonetheless, retail investors exhibit a preference for skewness (Mitton and Vorkink, 2007), or they are resourceful and able to gather better information about those stocks (Ivkovich, Sialm, and Weisbenner, 2008).

Second, retail investors trade excessively and do not follow buy-and-hold strategies. Active trading could be induced by behavioral biases. For instance, overconfident investors who over-estimate either the quality of their private information or their ability to interpret that information would trade excessively (Odean, 1999; Barber and Odean, 2000). Alternatively, excess trading can be due to perceived competence (Graham, Harvey, and Huang, 2009) or a desire to seek sensation (Grinblatt and Keloharju, 2009). However, aggressive trading by

investors could also reflect their attempts to exploit superior, time-sensitive private information (e.g., Kyle, 1985; Holden and Subrahmanyam, 1992). In this setting, active trading could be optimal and need not be excessive.

Third, retail investors exhibit a preference for local stocks, i.e., a disproportionately large proportion of their equity portfolios is invested in geographically proximate stocks. The preference for local stocks could be induced by familiarity (e.g., Huberman, 2001; Grinblatt and Keloharju, 2001) or by investors' superior information about firms located in their neighborhood (e.g., Ivkovich and Weisbenner, 2005; Massa and Simonov, 2006).

In each of these three settings, due to two conflicting explanations, there has been considerable debate in the literature about the underlying mechanisms that induce investors to hold concentrated portfolios, trade actively, and hold a disproportionate share of local stocks. Korniotis and Kumar (2008) offer a parsimonious explanation for the three puzzling findings that can accommodate both rational (information-based) and behavioral explanations. They conjecture that the investment decisions of investors with high cognitive abilities will reflect superior information, while the decisions of investors with low cognitive abilities are more likely to be induced by behavioral (or psychological) biases. Their conjecture is motivated by recent research in behavioral economics (e.g., Frederick, 2005; Benjamin et al., 2006; Dohmen, Falk, Huffman, and Sunde, 2007; Oechssler, Roider, and Schmitz, 2008), which finds that lower levels of cognitive abilities are associated with more "anomalous" preferences and stronger behavioral biases (e.g., greater level of impatience and stronger short-stakes risk aversion).

An Empirical Model of Cognitive Abilities

To test their conjecture, Korniotis and Kumar (2008) develop an empirical model of cognitive abilities by adopting the imputation method that is commonly used to link multiple data sets (Browning and Leth-Petersen, 2003). In particular, they estimate an empirical model of cognitive abilities in which a set of observable demographic variables including age are used to

predict the cognitive abilities of individuals. They use a data set that includes both direct cognitive ability measures and demographic variables. They apply this model to the brokerage data set and obtain the cognitive ability (or smartness) proxies for the retail investors in their sample. The authors follow the imputation approach because there is no U.S. data set available that includes both direct measures of cognitive abilities and investor's portfolio decisions.

In the empirical models, a direct measure of cognitive abilities is the dependent variable. The independent variables are the key correlates of cognitive abilities identified in the cognitive psychology literature. Like Cagney and Lauderdale (2002), Korniotis and Kumar (2008) use age, education, income, and wealth. They extend the model of Cagney and Lauderdale with an Over 70 age dummy variable because cognitive abilities dramatically decrease after the age of 70 (Baltes and Lindenberger, 1997). Consistent with Holtzman, Rebok, Saczynski, Kouzis, Doyle, and Eaton (2004), their cognitive model includes a social network proxy. Since the level and type of social activities change with retirement, their cognitive ability model also includes a retirement dummy variable.

The final set of cognitive ability correlates includes three interaction terms using three dummy variables. They are defined as Over 70 × Low Education, Over 70 × Low Income, and High Education × High Income. The interaction terms capture the prediction that cognitive abilities are likely to be lower among older investors who are less educated and less resourceful (Baltes and Lang, 1997).

To estimate this model, Korniotis and Kumar (2008) use data from the 2005 wave of the Survey of Health, Aging, and Retirement in Europe (SHARE). The survey is administered in 11 European countries to individuals who are at least 50 years old. The SHARE data contain three direct and standardized measures of cognitive abilities (verbal ability, quantitative ability, and memory) for more than 21,000 households. These measures are constructed based on responses from a paper-based survey. The SHARE data set also contains demographic variables such as age, income, wealth, education, gender, and a social network proxy. The

social network proxy is defined as the average level of social activities undertaken by a household, which includes sports, political and community activities, and religious activities. The assumption is that people who engage in more social activities will have larger social networks.

The cognitive abilities regression estimates in Korniotis and Kumar (2008) are consistent with the psychological evidence. First, cognitive abilities decline with age and are lower for very old individuals (age > 70). Abilities are also increasing with education and size of social networks. The strong positive relation between cognitive abilities and education is intuitive and consistent with the evidence from previous studies (e.g., Brown and Reynolds, 1975; Zagorsky, 2007). The authors find the coefficient estimates for wealth and income are significantly positive, although their magnitudes are weak. The relatively weak relation between cognitive abilities and income/wealth, conditional on age and education, is consistent with the previous evidence (Cagney and Lauderdale, 2002).

Overall, the cognitive abilities model estimates indicate that a few demographic characteristics can explain a significant proportion of the cross-sectional variance in people's cognitive abilities. In particular, age, education, social network, and wealth are strong correlates of cognitive abilities. Korniotis and Kumar (2008) also show that these findings are robust even when the cognitive ability regressions are estimated using U.S. data from the HRS.

Cognitive Abilities and the Three Puzzles

In their main empirical analysis, Korniotis and Kumar (2008) focus on three portfolio distortions: portfolio distortion, propensity to trade, and propensity to invest in local stocks. First, portfolio concentration is the sample period average number of stocks in the portfolio. The investors' propensity to trade is measured by monthly portfolio turnover rates (the average of buy and sell turnover rates). The investors' propensity to invest in local stocks is captured by a local stock preference (LP) proxy, which is defined as $LP = 1 - D_{act}/D_{portf}$. In this definition, D_{act} is the average distance between an investor's location and stocks in the portfolio, while D_{portf} is the

average distance between an investor's location and other characteristic-matched portfolios not held by the investor.

The authors use these three portfolio distortion measures to assess whether investors follow the normative prescriptions of the traditional portfolio theory (i.e., hold well-diversified portfolios and trade infrequently). They conjecture that when investors follow these prescriptions, having high cognitive abilities is unlikely to yield significant advantages. However, differences in cognitive abilities should significantly alter portfolio performance when investors depart from these normative prescriptions and intentionally distort their portfolios. Specifically, when investors' portfolio distortions are induced by psychological biases, the realized performance of their portfolios will underperform typical performance benchmarks. In contrast, when portfolio distortions reflect superior information, those portfolios will generate abnormal risk-adjusted returns.

To test their conjecture, Korniotis and Kumar (2008) sort investors independently using their imputed smartness estimates and the three portfolio distortion measures. For each of the three portfolio distortion measures, they compute the average portfolio performance of high (top quintile) and low (bottom quintile) cognitive abilities investor categories when the distortion level is low (bottom quintile) and high (top quintile).

They obtain the performance estimates of ability-distortion categories using characteristic adjusted stock returns (Daniel et al., 1997). Korniotis and Kumar (2008) measure the monthly characteristic-adjusted performance for each ability-distortion category and compute its time-series average to obtain the sample-period performance of the investor category. Panel A of Figure 30.2 shows the distortion-conditional average portfolio performance for low and high cognitive abilities investor groups computed using *gross* characteristic-adjusted returns. As shown in the figure, when portfolio distortions are low, on average, smart investors earn only one percent higher annualized, characteristic-adjusted returns than dumb investors.

But when portfolio distortions are significant, smart investors out-perform dumb investors by about six percent.

(Insert Figure 30.2 about here)

When Korniotis and Kumar (2008) use the Barber and Odean (2000) methodology to account for trading costs and measure the distortion-conditional performance differentials using net returns, the performance levels of both high and low cognitive abilities investors decline (see Panel B of Figure 30.2). The positive performance of high cognitive abilities investors is significant at the 0.05 level in two cases (portfolio concentration and local preference) and it is significant at the 0.10 level when the measured distortion uses portfolio turnover. The negative performance of low cognitive abilities investors is significant at the 0.05 level in all three instances. Further, the distortion-conditional performance differentials between the high and the low cognitive abilities investor groups remain positive and significant in all three instances ($\approx$ 5 percent). Overall, the evidence in Figure 30.2 indicates that the level of portfolio distortions and cognitive abilities jointly determine the portfolio performance. The authors confirm these findings from ability-distortion double sorts using multivariate cross-sectional regressions.

EVIDENCE FROM FINLAND

In two related studies, Grinblatt, Keloharju, and Linnainmaa (2009a, 2009b) use a comprehensive Finnish data set to examine whether high-IQ investors participate more in the stock market and whether they outperform low-IQ investors. Their data set is unique because they are able to consolidate information from multiple sources. In particular, their intelligence (IQ) index comes from the Finnish Armed Forces (FAF) intelligence score data. The FAF data are collected around the age of 19 or 20 when an individual joins the military. The FAF data are then merged with data from Finnish Central Security Depository (FCSD) registry, which includes information on daily portfolios and trades of all Finnish household investors over the period 1995 to 2002.

Grinblatt et al. (2009a) use the FAF and FCSD data to show that individuals with the highest IQ scores are the most likely to participate in the stock market. Specifically, they find that conditional on the known determinants of stock market participation, the lowest IQ individuals have a participation rate that is 17.6 percentage points less than that of the highest IQ individuals. Furthermore, the IQ-participation relationship remains strong even among the most affluent individuals in their sample.

Grinblatt et al. (2009b) examine whether high-IQ investors trade on superior information. Unlike the Korniotis and Kumar (2008) analysis that computes the performance estimates for each investor, they measure the average performance of all stock bought (sold) by IQ-sorted investor groups at a particular date. They then test whether stocks purchased (sold) by high-IQ investors subsequently earn higher (lower) returns in the near future. To test this key hypothesis, they estimate stock-level Fama-MacBeth regressions in which the dependent variable is the return of a stock at day *t*. The set of independent variables includes the average IQ level of investors buying and selling the stock in the recent past. Their analysis shows that the high-IQ investors' stock purchases predict price increases in the following month while sales of high-IQ investors' are not systematically related to subsequent price decreases. Based on these findings they construct investor-based portfolios and report that the abnormal returns of a portfolio constructed from yesterday's purchases of the highest IQ investors outperforms the comparable portfolio of the below-average IQ investors by about 10 percent. This result is consistent with the findings in the Korniotis and Kumar study, which shows that the return differential between portfolios of stocks with high- and low-ability investor clienteles is positive and economically significant.

Grinblatt et al. (2009b) also examine whether high-IQ investors are skillful and structure their trades so that they incur low transaction costs. Their main objective is to investigate when the transaction costs paid by high-IQ investors are lower than those paid by low-IQ investors. For this test, they integrate the Helsinki Exchanges (HEX) microstructure data to their investor-

level data set. The HEX data set includes every order submitted to the consolidated HEX limit order book. They again estimate stock-level Fama-MacBeth regressions in which the stock returns are computed by comparing the trade's actual execution prices to the average bid and ask prices at the time of execution or a few minutes later. The authors find that the market orders of high-IQ investors face significantly lower bid-ask spreads than the market orders of below-average IQ investors. This result complements the finding of Korniotis and Kumar (2008) that even after accounting for transaction costs, high skill investors continue to outperform low skill investors when portfolio distortions are high as shown in Panel B of Figure 30.2.

Overall, the evidence from the Grinblatt et al. (2009b) study indicates that high-IQ investors have better stock-picking abilities. High-IQ investors also appear more skillful because they incur lower transaction costs than low-IQ investors.

OTHER RELATED WORK

Thus far, the chapter has focused on the relation between cognitive abilities and investment decisions. This section summarizes studies that examine the effects of cognitive abilities in other economic settings.

In one of the early studies, Chevalier and Ellison (1999) examine the relationship between the performance of a fund and the characteristics of its manager. They use a sample of 492 managers who had sole responsibility for a fund for some part of the 1998-1994 period. The authors also collect biographical characteristics for these managers from Morningstar, Inc. Their evidence shows a negative relation between age and performance, even after controlling for various managerial attributes. They find this evidence puzzling and attribute it to managers' career concerns. However, their evidence is consistent with Korniotis and Kumar (2009), who argue that investment skill varies inversely with age. Chevalier and Ellison also find higher excess returns among mutual funds whose managers attended universities with higher average Scholastic Aptitude Tests (SAT) scores. Because SAT scores can proxy for IQ (Kanazawa,

2006), their results are consistent with the hypothesis that managers with more inherent abilities have better stock selection or market-timing abilities and thus can generate higher returns.

In another study, Grinblatt, Ikaheimo, and Kelojarju (2008) examine the choices of mutual fund investors instead of looking at manager fund performance. Using data from Finland, they gather the scores of mutual fund investors from IQ tests. Conditioning on income and wealth, they find that the fund fees paid by high-IQ investors are not significantly lower than the fees paid by low-IQ investors. Nevertheless, the high-IQ investors seem to be more skillful because, on average, they avoid balanced funds marketed through retail networks, which tend to carry the highest fees.

In another context, Agarwal et al. (2009) look at the price people pay for financial services such as home equity loans, auto loans, and credit cards. Using proprietary data, they report that middle-aged adults borrow at lower rates and pay fewer fees than younger and older adults. Moreover, the average age of peak performance across the ten studies is 53 years old. After considering various alternative explanations, they conclude that changes in experience and cognitive abilities across different age groups are the most plausible interpretation of their findings. The authors argue that young adults have little experience dealing with financial decisions and thus end up paying more for financial services. Older adults are also disadvantaged because of the age-related deterioration in their cognitive skills. These results from Agarwal et al. suggest that individuals with low cognitive abilities are potentially disadvantaged in making good financial decisions because they either do not know about the available financial products or do not fully understand their terms.

To further analyze consumer vulnerability, Mansfield and Pinto (2008) focus on developmentally disabled individuals, a demographic group with severe cognitive impairments. Through in-person interviews, they find that their respondents had a limited understanding of consumer credit cards. First, only 20 percent of the respondents reported that they either currently or previously owned a credit card. Second, none of the card holders they interviewed

could offer a totally correct definition of a credit card. This evidence is consistent with the evidence in Suto, Clare, Holland, and Watson (2005a) who find that the financial decision-making abilities of individuals with mild intellectual disabilities are worse compared to those of their counterparts in the general population and to more able individuals. In a related study, Suto, Clare, Holland, and Watson (2005b) also conclude that a direct relationship exists between intellectual disabilities and basic financial understanding.

The impact of cognitive abilities has also been related to the winner's curse—the finding that winning bidders in various auction settings systematically overbid and lose money as a consequence. In one such study, Casari, Ham, and Kagel (2007) conduct auction experiments to study the relationship between the SAT/ACT scores of the participants and their performance in experimental settings. They find that skilled participants with high SAT/ACT scores avoided the winner's curse more than unskilled participants. The authors also document an asymmetric effect. Participants with below median SAT/ACT scores are more susceptible to the winner's curse compared to participants with high SAT/ACT scores. Their results indicate that limits exist to how much experience can compensate for low abilities because participants with low SAT/ACT scores suffer from the winner's curse even as experienced bidders.

SUMMARY AND CONCLUSIONS

This chapter examines the impact of cognitive abilities on financial decisions. The extant evidence from the behavioral finance literature demonstrates that people with high cognitive abilities are more likely to participate in the stock market. Upon participation, investors with different cognitive abilities make different decisions which result in significant performance differential across ability groups. In particular, investment skill declines with age (a key determinant of cognitive abilities) and the decline is stronger for low income, low education investors who cannot successfully compensate for the adverse effects of aging.

These empirical findings make several important contributions to the growing literature on household finance. First, theoretical models typically have the greatest difficulty in explaining the participation rates in the extreme age categories (e.g., Gomes and Michaelides, 2005). One conjecture is that younger investors would stay away from the stock market due to their lack of investment experience, while older investors would be less willing to participate due to a perception of declining cognitive abilities. Second, previous theoretical models have examined the aggregate effects of aging on the stock market behavior (e.g., Bakshi and Chen, 1994; Poterba, 2001) through the channel of risk aversion. But age is likely to influence asset returns through an additional channel. Specifically, if older investors become aware of their declining investment skill, the perceived costs for stock market participation would increase, and those investors would demand a higher premium for investing in the stock market.

Finally, in light of this evidence, direct stock market participation might be a suboptimal strategy for low cognitive abilities investors. Indirect investments using mutual funds and other forms of delegated investment management might be more appropriate for those investors. Similarly, while there have been attempts to privatize the social security system, Kotlikoff (1996) and Mitchell and Zeldes (1996) note that, under a fully privatized system, the welfare of households that do not make “wise” investment decisions could be adversely affected. Echoing their concerns, the papers reviewed in this chapter suggest that households with low cognitive abilities are likely to make inferior investment decisions if they are allowed to directly invest their retirement wealth in the stock market. This evidence should be taken into consideration when evaluating the merits of a fully private social security system.

DISCUSSION QUESTIONS

1. How can the confounding effects of experience and cognitive aging be incorporated into traditional portfolio choice models?

2. Is the brokerage dataset described in this chapter representative of the average U.S. investors? Explain why or why not?
3. Do investors reduce their exposure to risk as they age? Discuss the research evidence.
4. The main cognitive ability model has been estimated using the SHARE data set, which includes information on European households. Is such a model appropriate for American households? Explain why or why not?
5. The imputed smartness measure is a linear combination of demographic characteristics. If investors are sorted using each of these demographic characteristics separately, what would be the return differential between smart and dumb investors?

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Figure 30.1 Investor Age and Portfolio Performance

This figure shows the average risk-adjusted performance level (annualized characteristic-adjusted percentage return) of age-sorted investor groups. The sample period is from 1991 to 1996. Investor data are from a large U.S. discount brokerage house.

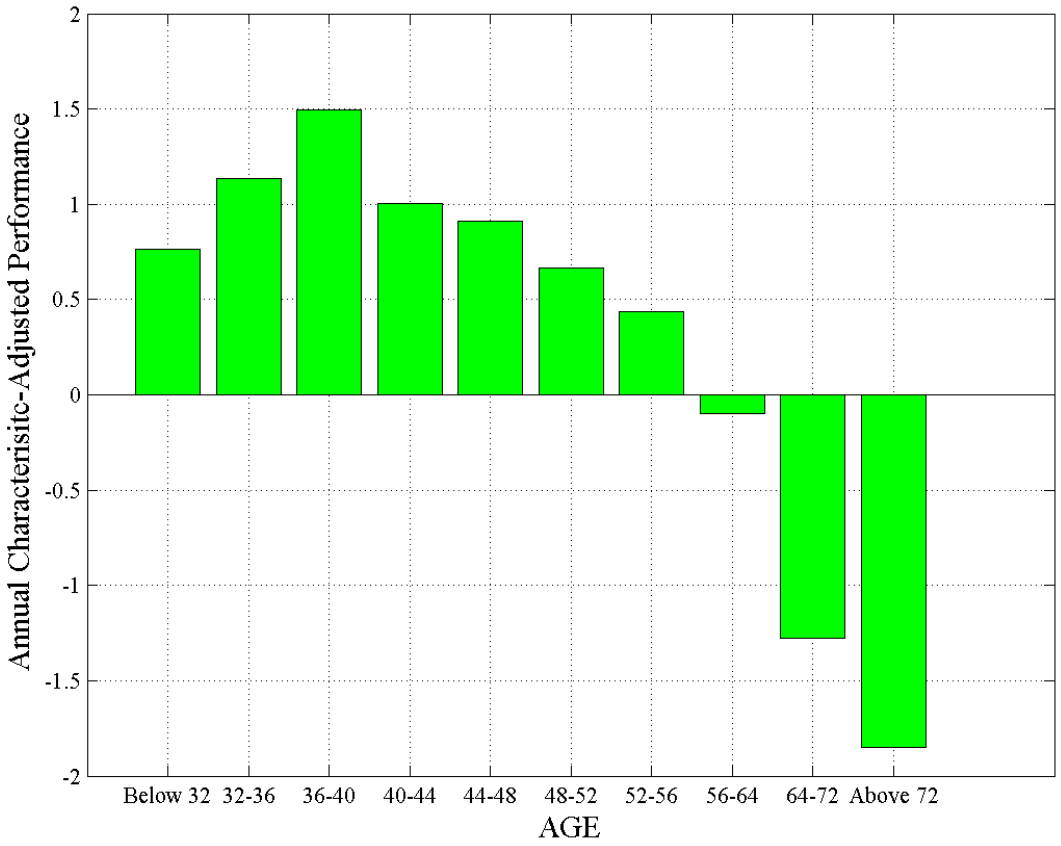
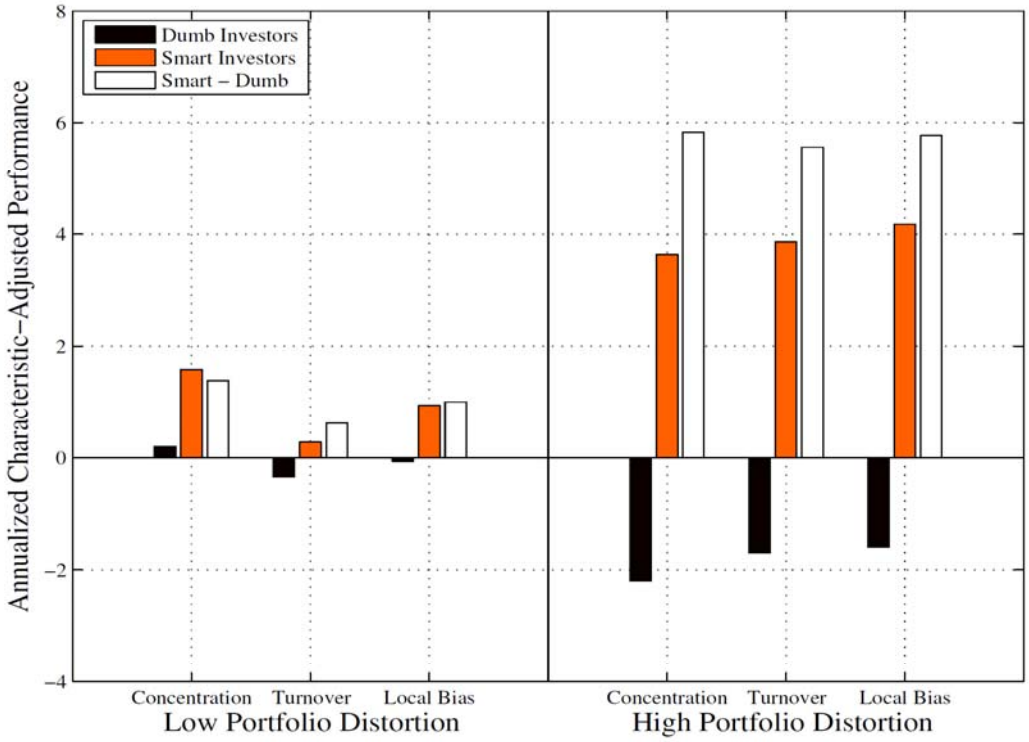


Figure 30.2 Cognitive Abilities, Portfolio Distortions, and Portfolio Performance

This figure shows the sample-period average annualized characteristic-adjusted percentage returns of ability-distortion investor categories. Panel A (Panel B) reports performance estimates using gross (net) returns. The characteristic-adjusted returns are computed using the Daniel, Grinblatt, Titman, and Wermers (1997) method. An empirical model of cognitive abilities is used to measure investors' cognitive abilities. Investors in quintile 5 (quintile 1) are identified as high (low) cognitive abilities investors. The low and the high portfolio distortion categories are defined in an analogous manner. Three distortion measures are considered: portfolio concentration, portfolio turnover, and local stock
preference.

Panel A: Performance Measures Computed Using Gross Returns



Panel B: Performance Measures Computed Using Net Returns