UNIVERSITY OF SOUTHAMPTON

FACULTY OF BUSINESS, LAW AND ART

School of Business

The effect of psychological and biological factors on financial choices

by

Di Wang

Thesis for the degree of Doctor of Philosophy

May 2018

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

FACULTY OF BUSINESS, LAW AND ART

School of Business

Thesis for the degree of Doctor of Philosophy

THE EFFECT OF PSYCHOLOGICAL AND BIOLOGICAL FACTORS ON FINANCIAL CHOICES

by Di Wang

The purpose of this thesis is to investigate the effect of psychological and biological factors on personal and household financial choices, which include asset allocation, wealth accumulation, pereference heterogeneity, and particular financial behaviours.

The psychological factors include cognitive abilities and personality traits. The first paper (Chapter 2) studies the effect of cognitive abilities on household portfolio choice with respect to assets shares and diversification. I use survey data from the Health and Retirement Survey (HRS) and English Longitudinal Survey of Aging (ELSA), which measure cognitive abilities, wealth composition, and detailed demographic information on aging populations in the US and the UK, respectively. I find that cognition is negatively associated with the percentage of investment in safe assets, but positively associated with the share of financial assets in retirement accounts. For households with low and median levels of financial wealth, these relationships are uniformly significant. However, the results do not support cognition as a predictor of the proportion of investments in risky assets. In addition, cognitive abilities are positively associated with the level of asset portfolio diversification. I discuss several possible explanations for why individuals engage in this portfolio shifting strategy and provide some practical implications.

The second paper (Chapter 3) investigates the effects of perfectionism on tolerance of financial risk and on wealth accumulation, and explores the possible channels through which these effects occur. Perfectionism encompasses two essential facets: strivings and evaluative concern. Financial risk tolerance is a subjective function of the financial risk that an investor can accept. I implement a cross-sectional study with an online survey sampling of 661 US residents. First, perfectionistic striving is positively associated with financial risk tolerance, but perfectionistic concerns have no impact on financial risk tolerance. Second, the positive link between perfectionism striving and financial risk tolerance is consistent in different demographic subgroups, based on gender, aging, religion, and marital status. Third, perfectionistic striving (concern) positively (negatively) predicts liquid wealth mediated by investment knowledge. Furthermore, investment knowledge, and investment knowledge followed by liquid wealth are two channels through which striving and evaluative concern affect risk

tolerance. Finally, perfectionistic concerns inhibit gambling expenditures. This study extends the understanding of the influence of perfectionism on individual financial well-being.

Circadian rhythm is the 24 hour-cycle biological process of living beings. The third paper (Chapter 4) examines the effect of chronotype on delinquent credit card payments and stock market participation through preference channels. Using an online survey of 455 individuals who have been working for 3 to 8 years in companies in mainland China, the results reveal that morningness is negatively associated with delinquent credit card payments. Morningness also indirectly predicts delinquent credit card payments through time preference, but this relationship only exists when individuals` monthly income is at low to average level. On the other hand, financial risk preference accounts for the effect of morningness on stock market participation. Consequently, an additional finding is that morningness is positively associated with financial risk preference, which contradicts previous findings in the literature. Finally, based on the empirical evidence, I discuss the plausible mechanisms that may drive these relationships and the implications for theory and practice. The current study contributes to the literature by examining the links between circadian typology and particular financial behaviours of experienced workers.

Table of Contents

List of Tables

List of Figures

Academic Thesis: Declaration Of Authorship

I, Di Wang

declare that this thesis entitled

The effect of psychological and biological factors on financial choices

and the work presented in it are my own, and have been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission.

Signed: Di Wang.....

Date: 21 May 2018.....

Acknowledgements

I would like to express my sincere thanks and gratitude to my main supervisor Professor Frank McGroarty for providing me the opportunity to conduct this research, assisting me with applying for the scholarship, and scheduling my research progress. His continuous support over the past few years has helped me through various difficulties. He has always provided me his support. His immense knowledge and valuable suggestions have given me the confidence to commence, correct and develop my research. Studying under his supervision has been a precious experience.

I am also grateful to my second supervisor, Dr Jeremy Cheah, for his support, patience and enthusiasm towards improving my research. In particular, he helped me with respect to statistical models for three papers, designing tables and using interaction items.

I would like to dedicate this doctoral thesis to my family. I want to express my sincere love and thanks to my parents for raising me and bearing so many life burdens to help me reach this level. They encouraged me to uncover my potential and overcome difficulties. Whenever I came to a crossroad, they always showed me the principled path towards character development and a valuable future.

I owe a debt of gratitude to my grandparents, who gave me the strength to finish my thesis and warmed my heart when I was going through a stressful periods. The many values and principles they taught me are amongst my most precious treasures.

I would like to extend my thanks to my sponsor, China Scholarship Council (CSC) for funding and granting my study throughout the past years. This support is gratefully acknowledged.

I also thank Professor Johnnie Johnson and Dr Andrew Urquhart for their productive comments and suggestions during my upgrade viva, which significantly enhanced my research.

I am thankful to the Institute Social Research centre at the University of Michigan for authoring me to access Health retirement survey data. I appreciate UK data service for allowing me to access the English longitudinal survey of aging data. Many thanks to Qualtrics and Wjx for providing respondents from their online panel to participate in my surveys.

With the oversight of my main supervisor, editorial advice has been sought. No changes of intellectual content were made as a result of this advice. I would like to acknowledge the editors from American Journal Experts and Liz Holliss, who were generous with their precious time in editing my papers.

I thank the participants at my presentations in Conferences IFABS 2016 and IAFDS 2016, especially Professor John Ashton who gave valuable suggestions concerning Chapter 2. I am grateful to peer students in University of Southampton for accompanying me on my journey.

Definitions and Abbreviations

IRA	Individual Retirement Account
ISA	Individual Savings Account
TESSA	Tax Exempt Special Savings Accounts
CDs	Bank certificate of deposits
HRS	Health and retirement survey
ELSA	English longitudinal survey of aging
GEE	Generalised Estimating Equation
CFPB	Consumer Financial Protection Bureau
SD	Standard deviation
PEP	Personal equity plans
MEQ	Morningness-eveningness questionnaire
CSM	Composite scale of morningness-eveningness
FRT	Financial risk tolerance
FL	Financial literacy

Chapter 1 Introduction

Financial well-being is a versatile concept that goes beyond both general financial literacy and the broader concept of financial capability. The Consumer Financial Protection Bureau defines that financial well-being as encompassing control over one's finances in both the short and long term, the capability to withstand financial shocks, the ability to achieve financial goals and the freedom to make choices that allow one to enjoy life (CFPB, 2015). Although the majority of people aspire to attain financial well-being, many become frustrated. Discrepancies in access to resources and opportunities admittedly predict much of the variance in financial well-being across individuals, but certain financial behaviours can enhance financial well-being despite obstacles. These behaviours consist of managing resources sufficiently, planning in advance, and making informed financial decisions (Drever et al., 2015). The CFPB (2015) proposed a theoretical framework that illustrated several factors and how they influence financial well-being. I displays this theoretical framework, including the factors in Figure 1.1, with a small modification. First, researchers believe that the social and economic environment can affect financial well-being by altering investment decisions and changing the available options. The factors belonging to the category of social and economic environment could, include family (Knüpfer et al., 2017), friends, community, culture (Gorodnichenko and Roland, 2017), social media (Bollen et al., 2011), government policies, the social security system (Gustman and Steinmeier, 2015), and the business cycle (Favilukis et al., 2017). However, these factors tend to be aggregated; thus, it is believed that individual differences can also explain the heterogeneity in financial well-being by shaping particular financial behaviours over the long-term (Xiao, 2008; pp. 69).

It is agreed in microeconomics, personal attributes, the decision context, and knowledge can jointly predict financial behaviours and subsequently influence financial well-being (CFPB, 2015). For example, a lack of financial knowledge and delayed gratification (attitude towards time) is associated with debt, which can increase stress and reduce financial well-being (Norvilitis et al., 2006). Consumers' preferences to save, budget, and control spending, partially depend on their perceived level of control over the possible outcomes, as well as their knowledge (Perry and Morris, 2005; Cobb-Clark et al., 2016). Materialistic values are positively associated with money management and can predict the level of savings or debt and compulsive purchasing (Donnelly et al., 2012). In addition, numeracy (one dimension of knowledge and skills) can predict wealth accumulation (Estrada-Mejia et al., 2016).

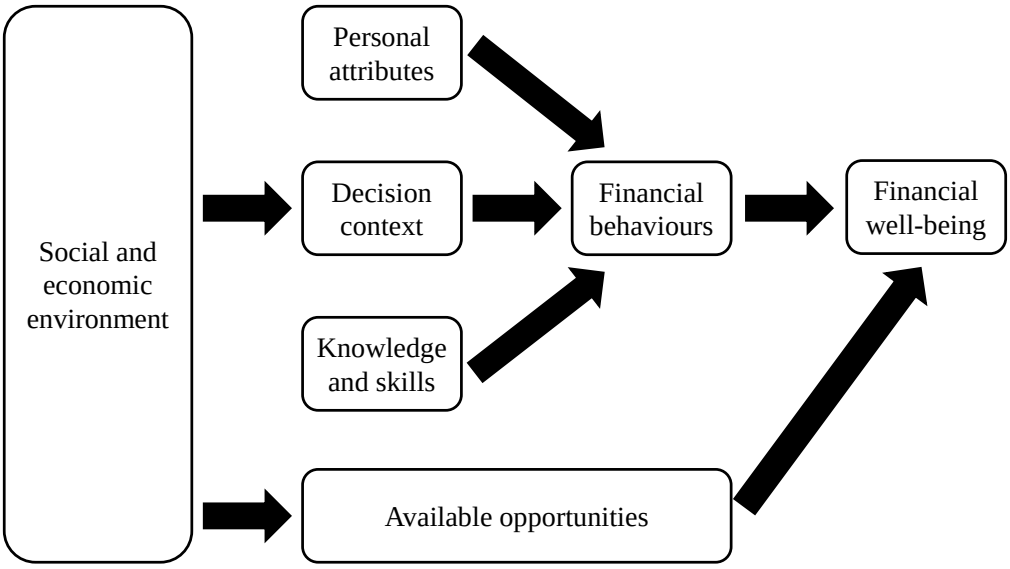


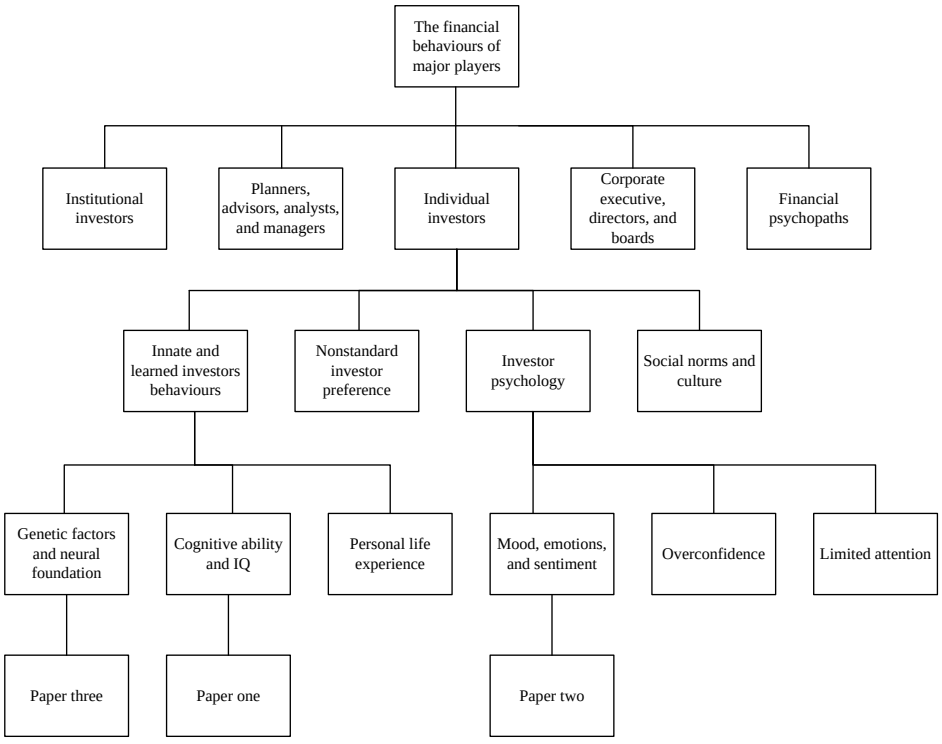
Figure 1.1 illustrates the factors that contribute to financial well-being; source: CFPB (2015)

The interest of this thesis pertains to the field of behavioural finance. By looking into the literature of behavioural finance, it helps to ascertain how it has been developing and provide insights for my thesis and each paper in it as well as identify the research gaps that can be filled. In general, there is a wide variety of participants in the financial markets, and they can be categorized into five groups: 1) individual investors; 2) corporate executives, directors, and boards; 3) institutional investors; 4) financial planners, advisors, analysts, and portfolio managers; and 5) financial psychopaths (Baker et al., 2017). Because the subject of interest in this thesis is individual investors, I show a holistic view of the various factors that affect financial behaviours and decision-making of individual investors, which not only include traditional economic incentives but also biological roots, life experience, and psychology as well as social norms and culture (Cronqvist and Jiang, 2017). Figure 1.2 outlines this holistic paradigm and highlights the research gaps towards which each paper in this thesis can contribute.

Here, I provide my rationale for how I shaped each paper according to the particular stream of literature and sketch the content of each paper. First, cognitive abilities fall into the category of knowledge and skills (CFPB, 2015). Cognition demands the integration of a vast number of mental processes, involving recognition, memory (McArdle et al., 2002), symbolism, language, inference making, problem-solving and decision-making (Smith et al., 2002). With the increasing complexity of financial markets, the cost for retail investors to overcome information barriers and earn profits is higher, thus requiring higher cognition levels, in terms of memory, numeracy, financial literacy and general IQ. A stream of recent papers examines the effect of cognition level on willingness to participate in the stock market. For example, Christelis et al. (2010) reported that cognitive abilities are associated with stock market participation, but they

did not examine whether cognitive abilities influence the allocation of other assets, such as retirement accounts that play an important role in providing stable wealth situation. Van Rooij et al. (2011) and Grinblatt et al. (2011) discover that the probability of holding stock asset is positively associated with financial literacy and IQ. Finally, I propose to examine whether cognitive ability may contribute to shaping a particular investment strategy, such as shifting investments away from risky assets and safe assets, but increasing the share of investment in retirement accounts, which have tax-deferred or tax-free advantages, and are simultaneously less risky than risky assets and provide higher returns than safe assets. The first paper (Chapter 2) examines the effect of cognitive abilities on household portfolio choice from the perspectives of asset share and diversification. I use survey data from the Health and Retirement Survey (HRS) and the English Longitudinal Survey of Aging (ELSA), which measure cognitive abilities and wealth composition, using detailed demographic information on the aging population in the US and the UK, respectively. I find that cognition is negatively associated with the percentage of investments in safe assets, whereas the share of financial assets in retirement account is positively related to cognitive abilities. For households with low and median levels of financial wealth, these relationships are uniformly significant. Nevertheless, the results do not support cognition as a predictor of the proportion of investments in risky assets. Moreover, cognitive abilities are positively associated with the level of asset diversification. I discuss several possible explanations for why individuals engage in such portfolio-shifting strategies and provide some practical implications.

Figure 1.2 provides a holistic paradigm of behavioural finance according to the different players in financial markets (Cronqvist and Jiang, 2017) and highlights the research gaps that each paper in this thesis aims to contribute towards.



Second, within the framework of personal attributes, the internal relationships between different factors remain uncertain, especially the relationship between personality traits and preference heterogeneity. The latter captures three dimensions of utility functions with regard to goods, time, and uncertainty through risk preference, time preference, and uncertainty aversion (Andersen et al., 2008). On the one hand, personality traits predict financial well-being. For example, Brown and Taylor (2014) discover that the amounts of unsecured debt and financial assets owned by households are associated with personality traits, and further uncover the link between personality traits and willingness to participate in stock markets. Mosca and McCrory (2016) find that of the 'Big Five' personality traits, emotional stability and extraversion are positively related to wealth accumulation. Additionally, conscientiousness is also positively related to wealth accumulation, but the relationship is only significant at the lower end of the wealth continuum. On the other hand, personality traits are also associated with preference heterogeneity. For instance, in the Big Five personality framework, openness to experience, neuroticism, and agreeableness are all associated with risk aversion (Dohmen et al., 2011; Borghans et al., 2009). Therefore, recent studies have begun to examine the effect of personality traits on both preference heterogeneity and financial behaviours (Lauriola and Levin, 2001), but these studies all use the taxonomy of the Big Five personality traits (McCrae and Costa, 1997; Allik, 2005). In fact, there are other personality traits that have not yet been taken into account with regard to their effect on economic decision-making, economic preferences, wealth accumulation or gambling behaviours. Perfectionism is one of the traits outside the scope of the Big Five. Perfectionism encompasses two essential dimensions: perfectionistic strivings and perfectionistic concerns. The former (latter) dimension is the positive (negative) facets of perfectionism (Stoeber and Otto, 2006). I intend to contribute by examining the relationship between perfectionism, which is not within the scope of the Big Five personality traits, and risk attitude, and I further explore whether perfectionism predicts risky financial behaviours, such as gambling. The second paper (Chapter 3) investigates the effect of perfectionism on tolerance of financial risk and wealth accumulation and explores the possible channels through which this effect operates. Perfectionism encompasses two essential facets: strivings and evaluative concerns. Financial risk tolerance is a subjective function of the financial risk that an investor can accept. I conduct a cross-sectional study using an online survey of 661 US residents. First, perfectionistic striving is positively associated with financial risk tolerance, but perfectionistic concerns have no impact on financial risk tolerance. Second, the positive link between perfectionistic striving and financial risk tolerance is consistent in different demographic subgroups that are categorized by gender, aging group, religion, and marital status, respectively. Third, perfectionistic striving (concerns) positively (negatively) predicts the level of liquid wealth mediated by investment knowledge. Furthermore, investment knowledge, and investment knowledge followed by the liquid wealth are two channels through

which striving and evaluative concerns influence risk tolerance. Finally, perfectionistic concerns inhibit gambling expenditures. This study thus extends the knowledge of the functional role of perfectionism on individual financial well-being.

Third, biological factors are also personal attributes that vary among individuals. Circadian rhythm is a biological process that results in a daily cycle of physical, mental, and behavioural changes, and circadian typology is a representative expression of it, which classifies ones in three types: morning-, median, and evening-type (Natale and Cicogna, 2002). Recent research have begun to detect whether and how the circadian typologies affect economic preferences (Stolarski et al., 2013; Wang and Chartrand, 2015; Milfont and Schwarzenthal, 2014). I aim to contribute by finding the evidence that circadian typologies are linked to economic preferences and in turn affect financial behaviours, such as accumulating credit card debt and participating in the stock market. The third paper (Chapter 4) examines how circadian typologies affect the delinquent credit card payments and stock market participation. Based on an online survey of 455 individuals who have been working for 3 to 8 years in companies in mainland China, the results reveal that morningness is negatively associated with incomplete credit card payments. Morningness also indirectly predicts incomplete credit card payment through time preference, but this relationship only exists when individuals` monthly income is at low and average levels. On the other hand, financial risk preferences account for the effect of morningness on stock market participation. Consequently, an additional finding is that morningness is positively associated with financial risk preference, which contradicts the finding in the literature. Finally, based on the empirical evidence, I discuss plausible mechanisms that may drive these relationships and the implications for theory and practice based on empirical evidence. This study contributes to the literature by examining the links between circadian typology and the particular financial behaviours in experienced workers. Table 1.1 outlines the research questions and the contributions of papers.

The remainder of this thesis is organized as follows. Chapter 2 constitutes the first paper. Chapter 3 is the second paper. Chapter 4 forms the third paper. Chapter 5 concludes this thesis.

Table 1.1 outlines the research questions and their associated papers.

Paper title	Research Questions	Research Contribution	Chapter No.
1. Do cognitive abilities influence household portfolio choices in retirement? Empirical evidence from the US and the UK	1. Do cognitive abilities influence the allocation of household financial assets? If so, how? 2. Do cognitive abilities predict the extent of diversification of household financial assets? 3. Is there a particular investment strategy that aging households tend towards?	The first paper expands upon behavioural finance literature by shedding light on an observable phenomenon: a shifting strategy in household portfolios for aging groups. 2. It emphasizes the role of cognition to predict the change in asset shares and diversification. 3. It gives practical implications to prevent wealth shrinkage among the older generations.	2
2. Does perfectionism affect individual financial risk tolerance, wealth accumulation, and gambling behaviour?	1. Does perfectionism predict the tolerance of financial risk and wealth accumulation? 2. What are the possible channels, e.g., investment knowledge? 3. Does perfectionism predict risky financial behaviours, such as gambling?	1. The second paper expands upon behavioural finance literature and risk attitude theory by demonstrating a positive association between perfectionistic striving and risk attitude. 2. It posits that investment knowledge is one channel through which perfectionism predicts wealth accumulation. 3. It highlights that perfectionistic concerns reduce monthly gambling expenditures among regular gamblers.	3
3. Chronotype, risk and time preferences, and financial behaviours	1. Does chronotype predict personal differences, e.g., risk preference and time preference? 2. Does chronotype influence debt credit behaviour (e.g., delinquent credit card payments) and risky investment behaviour (e.g., stock market participation)? 3. Are risk and time preferences the channels through which chronotype influences these behaviours?	1. The third paper expands upon existing literature by analysing the link between chronotype and financial behaviours. 2. It highlights the mediating roles of time preference in the relationship between chronotype and revolving credit use, and the mediating role of risk preference in the relationship between chronotype and stock market participation. 3. It expands upon the behavioural finance literature by bringing physiological factors into consideration when studying financial behaviours	4

Chapter 2 Do cognitive abilities influence household portfolio choices in retirement? Empirical evidence from the US and the UK

Abstract

This paper studies the effect of cognitive abilities on household portfolio choices related to assets shares and diversification. I use survey data from the Health and Retirement Survey (HRS) and English Longitudinal Survey of Aging (ELSA), which measure cognitive abilities, wealth composition, and detailed demographic information of aging populations in the US and the UK, respectively. I find that cognition is negatively associated with the percentage of investment in safe assets, but positively associated with the share of financial assets in retirement accounts. For households with low and median levels of financial wealth, these relationships are uniformly significant. However, the results do not support cognition as a predictor of the proportion of investments in risky assets. In addition, cognitive abilities are positively associated with the level of asset portfolio diversification. I discuss several possible explanations for why individuals engage in this portfolio shifting strategy and provide some practical implications.

2.1 Introduction

Household investors have become progressively vigorous in financial markets (Van Rooij et al., 2011). Economic theory anticipates that households will have well-diversified portfolios, which is a balanced allocation of assets with varying risk levels. The extent to which this anticipation is valid relates to the rules of consumer financial instruments and retirement savings plans, which promote consumer well-being in general (von Gaudecker, 2015). The efficient market hypothesis proposed by Fama (1970) assumes that individuals are rational and fully informed. However, previous studies report that in reality, a sizeable proportion of the adult population has limited knowledge about finance and that many adults do not understand fundamental economic concepts (Jappelli and Padulav, 2013). In addition, market liberalization and structural reforms to social security and pensions present another challenge to retail investors, because the responsibility has shifted from authorities and companies to individuals. Therefore, retail investors must bear more responsibility for their financial welfare (Van Rooij et al., 2011). One component of this responsibility is the cost of transactions and information, which has been proposed as the primary reason why household investors do not invest in certain financial assets and do not have a significant share of risky assets (Vissing-Jorgensen, 2003). One way to eliminate transaction and information costs that has been empirically studied is to improve investors` cognitive abilities, and financial. These studies mainly investigate the relationship between cognitive abilities/ financial literacy and asset holding (i.e., the probability of choosing a particular asset). For instance, Christelis et al. (2010) find that a lack of cognitive abilities can explain limited participation in financial markets, mainly due to the costs associated with information barriers, and Van Rooij et al. (2011) and Grinblatt et al. (2011) discover that the probability of owning stock is positively associated with financial literacy and intelligence quotient (IQ), respectively. However, few papers endeavor to research the relationship between cognitive abilities and financial asset allocation or the effect of cognition on the degree of portfolio diversification. By exploring the issue from these two perspectives, I can obtain a systematic account of the features of cognitive abilities that affect decision making related to household portfolios.

This paper investigates within- and across-country variances in cognitive factors and investment portfolio choices using a longitudinal analysis. The dataset includes eight waves of the Rand Health and Retirement Study (HRS), which covers a representative sample of the American population aged 50 and higher, and five waves of the English Longitudinal Survey of Aging (ELSA), which encompasses a representative sample of the English population. The design and data of the ELSA are comparable to those of the HRS.

The measurement of cognitive abilities in the US sample is a general indicator in the form of a sum score that contains information about recognition, memory, numeracy skills, and language, which are the main dimensions of cognition. Instead of using multiple dimensions of cognitive ability, I use this general indicator because the general effect of cognitive abilities on portfolio choices has not yet been studied and empirically proved. In contrast to the US measure, the measure of cognitive abilities for the UK sample is a one-dimensional sum score based exclusively on work recall tasks; this limitation is due to the unavailability information on other cognitive dimensions (e.g., mathematical skills) in the UK data. Although the measures of cognitive abilities differs between the two countries, the measure used in the UK sample captures the core dimensions of cognition, i.e., memory and language, and hence, I believe that it can predict variance in the main interests related to cognitive abilities. The conventional four-class scheme (risky assets, bonds, IRAs and risk-free assets) proposed by Rosen and Wu (2004) is applied in the present paper. This scheme is convenient for constructing the benchmark that measures investment shares in different assets (0 to 1) and the degree of portfolio diversification (1 to 4). Moreover, to isolate the effect of cognitive abilities from those of other factors, conventional control variables are selected in this study, including age, education, health, income, and wealth.

Regarding the econometrics specification, because the proportions of financial portfolios invested in different assets are fractional, I employ the population-averaged panel data models (i.e. fractional probit models in a panel setting) proposed by Papke and Wooldridge (2008). In addition, because the degree of portfolio diversification is ordinal and discrete in panel data, I utilize the fixed effect ordered logistic model proposed by Baetschmann et al. (2015) and further modified by Dickerson et al. (2014). In addition, to examine the entire samples respectively from the US and the UK, I split each dataset into the coupled households and single-head households. This strategy allows us to isolate the effect of cognitive abilities on investment shares in different assets from the corresponding effect of family composition (i.e., gender composition) and to assess whether this effect exists and/or differs between these subgroups. The reason for this process is that coupled and single living people have different portfolio strategies (Barber and Odean, 2001; Lundberg et al., 2003) and because barging may be involved in couples` financial decision-making (Lundberg et al., 2003; Kirchler et al., 2008). The results show, first, that there is a negative correlation between cognitive abilities and the share of investments in risk-free assets. Second, I find that individuals with higher cognitive levels prefer to allocate a larger proportion of their investment to individual retirement (or savings) accounts. Third, the level of portfolio diversification is positively related to cognitive abilities. Finally, the effect of cognition on investment shares in specific assets do not consistently and significantly differ between the coupled group and the single-headed group.

These results imply that cognitive abilities, as a form of human capital, are an active determinant of financial wealth composition and diversification. Households with higher cognition levels tend to tolerate more risk and engage in a greater degree of diversification in order to obtain better investment outcomes. This association between cognitive abilities and portfolio choice does not appear to be influence by household composition.

Given that financial literacy and the wealth are mutually determined (Jappelli and Padula, 2013), I test whether the accumulation of wealth moderates the effect of cognition on financial asset allocation. Empirically, the results show that the positive effect of cognition on the share of investment in retirement accounts is moderated by wealth, indicating that wealth accumulation affects the positive correlation between cognitive abilities and the proportion of individual retirement assets in total financial assets. Because wealth is a predictor of well-being (Ryan and Deci, 2001), it is understandable that households with both higher cognition and higher levels of wealth tend to be less motivated to increase the share of their investments in individual retirement assets than households with higher cognition but a lower level of financial wealth.

The remainder of this paper is organized as follows. Section 2.2 presents a literature review regarding cognition, decision making in general contexts, and portfolio composition and diversification. Section 2.3 introduces the data, corresponding measures, and summary statistics. I describe the econometrics and report the results in Sections 2.4 and 2.5, respectively. I discuss the empirical findings in Section 2.6 and conclude in Section 2.7.

2.2 Literature Review

First, this section introduces the literature regarding cognitive abilities and household portfolios. Then, I elucidate the specific research questions and corresponding hypotheses. Although each variable is well studied in its field, few studies have explored the relationships between them, which provide a gateway to more sophisticated and comprehensive knowledge about the effect of cognition level on household portfolio choices.

2.2.1 Cognitive abilities and decision-making

The term ‘cognitive abilities’ refers to mental activities related to the acquisition, deposit, recollection and use of knowledge. It integrates a vast number of mental processes involved in recognition, memory (McArdle et al, 2002), symbolism, language, inference making, problem-solving and decision making (Smith et al., 2002). Decision making is an elementary cognitive procedure of humans by which an optimal option or a course of conduct is selected from several alternatives based on certain benchmarks (Wang and Ruhe, 2007). In psychological theory,

Raiffa (1968) maintains that decision-making processes include four elementary abilities: appraisal of beliefs, assessment of values, integration of beliefs and values to making choices, and acquisition of a meta-cognitive understanding of individual capabilities.

Recent research has shown a growing interest in the connection between cognitive abilities and decision-making (Li et al., 2013). Current papers in the economic field provide empirical evidence that sheds light on the complexities involved in the effect of cognitive abilities on economic preferences. Shamosh and Gray (2008) report that higher cognition is associated with a preference for shorter time periods. Dohmen et al. (2010) show that those with lower cognitive abilities tend to be more risk averse, and to discount more for time. Agarwal and Mazumder (2013) present empirical evidence that individuals with higher cognitive abilities-especially, those with higher math-related cognitive abilities-are less likely to make financial mistakes.

More recent papers explore the relationship between cognitive abilities and financial behaviours, with a particular emphasis on straightforward games (e.g., prisoner`s dilemma and trust) and sophisticated games (e.g., bank runs and Schelling games). Notably, Benito-Ostolaza et al. (2016) suggest that individuals with higher cognitive levels tend to adopt complicated strategies. Kiss et al. (2016) argue that people with higher cognition levels are better at developing strategies than are people with lower cognition levels. These papers indicate that higher cognitive levels can lead to better quality of rational decisions in the economic game. Although other papers report that behaviour in the economic game is affected by social preference rather than cognitive abilities (e.g., Al-Ubaydli et al., 2016; Bayer and Renou, 2016), authors on both sides express an interest in exploring the role played by cognitive abilities in economic decision making.

2.2.2 Household portfolio choices

The allocation of financial assets by households is a type of decision-making. Recent theoretical literature on portfolio choices describes a dynamic framework in which individuals allocate their portfolios to maximize the expected lifetime utility. Elementary concerns include incomplete portfolios (King and Leape, 1998), human capital uncertainty (Heaton and Lucas, 1997), the ability to substitute labor income for asset income (Bodie et al., 1992), and uncertain planning horizons (Foldes, 2000).

The related empirical literature on portfolio choices endeavors to detect observable factors that explain differences in portfolio choices related to total wealth accumulation, the probability of investing in a specified asset, and the proportion allocated to this specified asset. Several categoreis of factors have been identified in these previous papers. First, demographic information, such as household wealth (Peress, 2004), household income (Krusell and Smith,

1997), age (Benzoni et al., 2007), ethnicity, gender (Sunden and Surette, 1998), marital status, number of children (Love, 2010), and retirement (McArdle et al., 2009). Second, physical health (Rosen and Wu, 2004; Yogo, 2016) and mental health (Bogan and Fertig, 2013). Third, cognition-related variables, such as cognitive abilities, IQ, and financial literacy. These studies lay the groundwork for future research on complexities patterns of household portfolio choices.

2.2.3 Cognitive abilities and household portfolio choices

An emerging segment of empirical literature reports that cognitive skills are a prominent indicator of variance in portfolio choice. In particular, McArdle et al. (2009) report that the measures of cognitive abilities are valuable predictors of wealth accumulation. Behrman et al. (2010) contribute evidence that financial literacy (which is a measure of cognitive abilities that is limited to the financial context) can significantly positively predict household wealth accumulation using instrumental estimations. Van Rooij et al. (2012) also discover that financial literacy plays an important role in wealth accumulation and suggest that this relation is probably due to two factors: first, people with higher financial literacy are more likely to participate in the stock market, and second financial literacy is helpful when planning and developing retirement investments. Thus, these two papers bridge the gap between cognitive skills and wealth accumulation.

More recently, another strand of the literature has studied whether cognitive abilities affect the probability of households to taking part in the stock market. Christelis et al. (2010) report that willingness to participate in the stock market is substantially associated with cognitive abilities. They also argue that the channel through which cognitive abilities affect stock market participation is information barriers rather than risk preferences, time preferences, or other psychological features. Following Christelis et al. (2010), other papers have studied similar research questions but using different measures of cognitive abilities, such as financial literacy (Van Rooij et al., 2011) and IQ (Grinblatt et al., 2011), both of which are positively associated with the propensity to own stock.

These papers contribute to the financial and economic literature by documenting the positive association between cognitive abilities, wealth accumulation, and the probability of investing in the risky assets. However, few papers have probed the effect of cognitive abilities on the proportion invested in different financial assets, or on the level of diversification of financial assets. For instance, Christelis et al. (2010) investigate the effect of cognitive abilities on the share of financial wealth invested in risky (stock and mutual fund) assets but find no evidence to verify this effect. Bogan and Fertig (2013) indirectly examine the influence of cognitive limitation (a reverse-coded measure of cognitive abilities) on the share of risky assets owned,

but report a non-significant result. Balloch et al. (2015) reveal that financial literacy affects the share of investment in risky assets but do not consider the potential relationships between other cognitive abilities and the percentages of total assets invested in other types of financial assets, such as risk-free assets and individual retirement accounts (IRAs), which is a gap in the literature that we intend to explore. A study by von Gaudecker (2015) indicates that portfolio under-diversification is a very costly financial mistake, showing that households with high financial literacy or professional financial assistance obtain acceptable returns whereas households with low and median finanical literacy obtain outcomes 50% below the average. However, the portfolios studied in that paper are limited to stocks and mutual funds, the sample size is relatively small (less than 300 households), and the method used is a cross-sectional analysis. Therefore, I aim to expand on this study by testing the effect of cognitive abilities on a more generalized portfolio composition, using a larger sample, and applying a longitudinal analysis to better capture the complexities of dynamic decision making regarding portfolio allocation.

2.2.4 Hypotheses development

To address the relationship between cognitive abilities and the proportions invested in different assets, I examine three hypotheses related to risk-free assets, IRA (ISA) assets, and risky assets.

First, for the risk-free assets, I have **Hypothesis a1**: *Cognitive abilities are negatively associated with the share of investment in risk-free assets.* Christelis et al. (2010) argue the channel through which cognitive abilities affect the likelihood of participate in risky asset is the cost of dealing with information. Therefore, I expect that heads of households with higher cognitive abilities will tend to invest smaller shares in risk-free assets, compared other heads of households, because if the cost to process information is lower, then it is rational to expect that people will maximize their benefits by tolerating higher risk levels.

Second, I have **Hypothesis a2**: *Household composition moderates the effect of cognitive abilities on the share of investment in risk-free assets.* The reasoning behind this hypothesis is that coupled households may engage in bargaining, whereas single-headed households make decisions regarding portfolio allocation by themselves. If I could find empirical evidence to support hypothesis a1, I expect that the effect of cognitive abilities on the share invested in risk-free assets will differ between coupled households and single-headed households.

Third, I have **Hypothesis a3**: *Financial wealth moderates the effect of cognitive abilities on the share of investment in risk-free assets*. According to Jappelli and Padula (2013), financial literacy positively interacts with wealth over a person`s life cycle. If I could find empirical

evidence to support hypothesis a1, I expect that the effect of cognitive abilities on the share invested in risk-free assets will vary among households with different levels of financial wealth.

Below, I present corresponding hypotheses regarding the share of investments in IRA (ISA) assets (**Hypotheses b1, b2 and b3**) and in risky assets (**Hypothesis c1, c2, and c3**).

Hypothesis b1: *Cognitive abilities are positively associated with the share of investment in retirement accounts.*

Hypothesis b2: *Household composition moderates the effect of cognitive abilities on the share of investment in retirement accounts.*

Hypothesis b3: *The total value of the financial assets moderates the effect of cognitive abilities on the share of investment in retirement accounts.*

Hypothesis c1: *Cognitive abilities are positively associated with the share of investment in risky assets.*

Hypothesis c2: *Household composition moderates the effect of cognitive abilities on the share of investment in risky assets.*

Hypothesis c3: *The total value of financial assets moderates the effect of cognitive abilities on the share of investment in risky assets*.

Finally, to address the question whether cognitive abilities affect the degree of portfolio diversification, I present **Hypothesis d**:

Hypothesis d: *Cognitive abilities positively affect the extent of financial portfolio diversification (i.e., the number of financial asset types that one household have)*;

The outcomes achieved by th financial portfolios of households with higher financial literacy or the benefit of professional advice is greater than those achieved by households with low or median levels of financial literacy that do not have the benefit of professiaonal assistance (von Gaudecker, 2015). Therefore, I anticipate that the degree of financial portfolio diversification is positively correlated cognitive abilities.

Figure 2.1 plots the hypothesized relationships. The red text shows the direct effects of cognition on the shares of investment in particular assets. The black text represents the moderation effects of household composition and wealth on the relationship between cognition and the percentages of investment in particular assets.

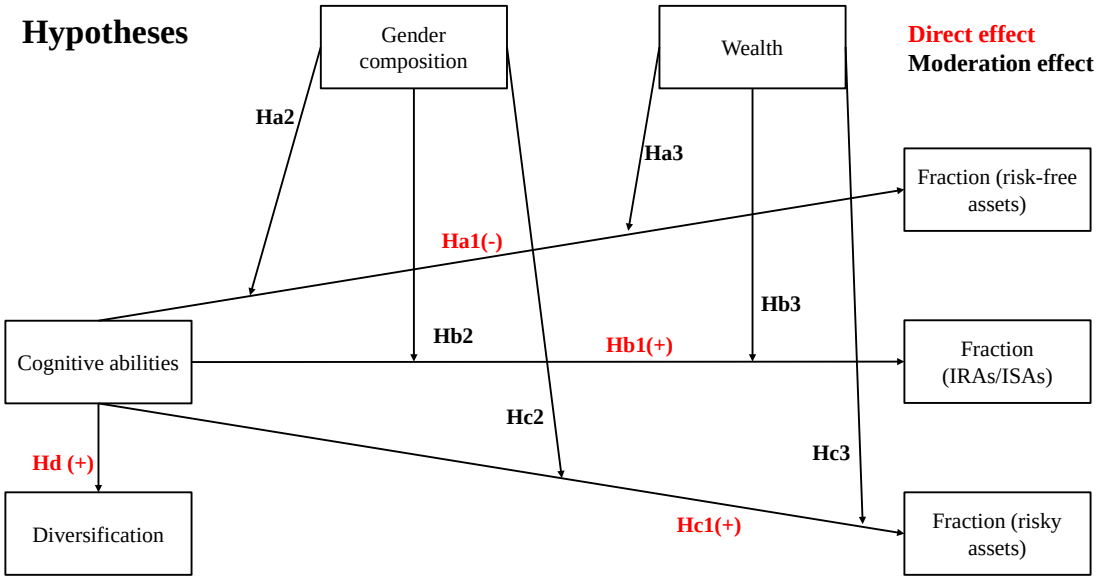


Figure 2.1 depicts the hypothesized relationships. The red text shows the direct effects of cognition on the shares of investment in particular assets. The black text represents the moderation effects of household composition and wealth on the relationship between cognition and the percentages of investment in particular assets.

2.3 Data and measures

The data comes from eight waves of the HRS (Juster and Suzman, 1995) conducted from 1996 to 2010 and five waves of the ELSA (Steptoe et al., 2012) conducted from 2002 to 2010. HRS (ELSA) is a national survey data that collects aging household population data biennially in the US (the UK). Both surveys provide precise information regarding financial and economic status, health, cognition, and demographic details. The majority of respondents in these surveys are aging people (i.e., people who are more than 50 years old). Although this data only include aging and elderly populations, which warrants the use of caution when generalizing my findings, there is an advantage to analyzing only those people who have certain future earnings; specifically, the explanation for the change of investment in different financial assets is easier (Hurd, 2002). The main reason to use data from both the US and UK is the similarities between two countries, including in terms of language, heritage (Blundell et al., 2016), and the maturity of their financial markets. However, difference between them also exist, for example, with respect to institutions, asset returns, and certain cultural dimensions (Hofstede, 1980; Hofstede, 2003). Figure 2.2, taken from the Hofstede center (https://geert-hofstede.com/countries.html), compares the US and the UK in term of their scores on six cultural dimensions. I can see that there are remarkable differences between the two countries in uncertainty avoidance and long-term orientation. The diagram shows that British people are more comfortable with uncertainty, compared with their North American counterparts. In addition, British households appears to be more long-term oriented than American households are. Given the similarities and differences between these countries, it is useful to determine whether cognition is a potential

driver of the portfolio choices of households in retirement over time and whether the impact of this driver is consistent in different countries.

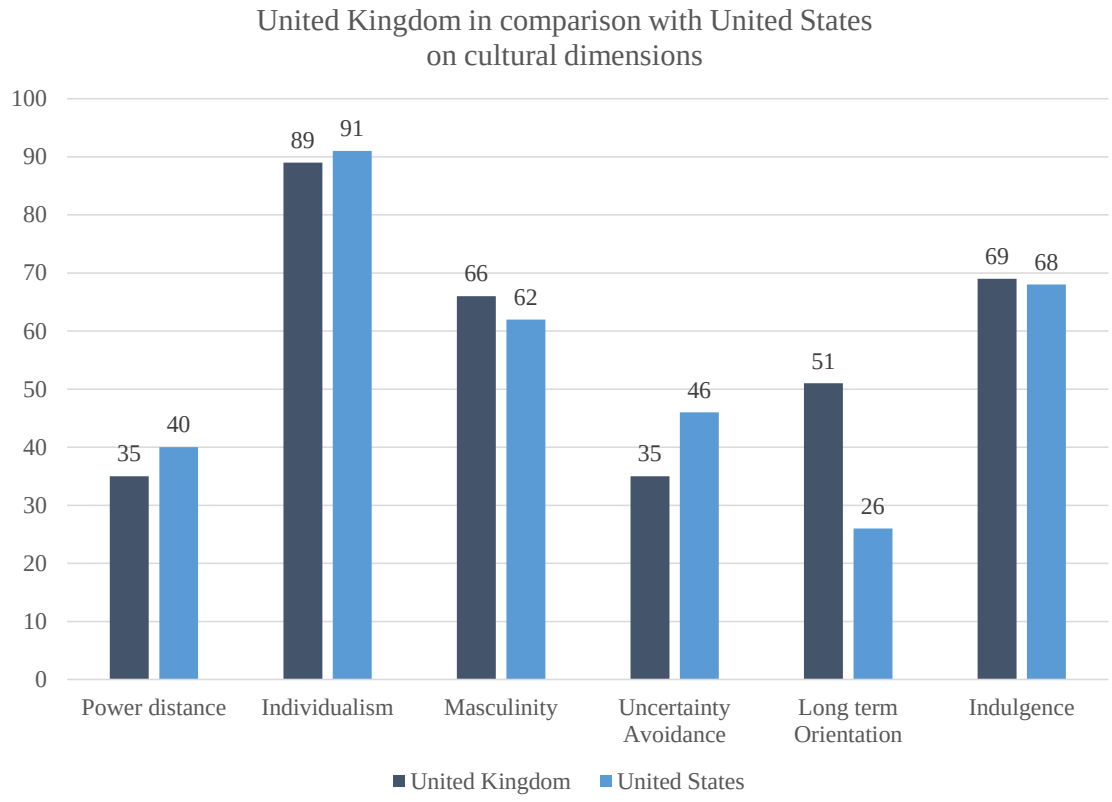


Figure 2.2: The source of this diagram is the Hofstede Center (https://geert-hofstede.com/countries.html). This website provides tools to describe national cultures in six dimensions, based on the theory proposed by Hofstede (1980) and Hofstede (2003).

Another question relates to the conditions necessary for a cross-country comparison study. In this regard, ELSA is comparable to HRS because ELSA was designed in accordance with HRS. In particular, the time planning and structure of the survey, measurements of financial assets and household income, cognitive measures, and demographic information parallel each other. Therefore, I may expect cross-country differences in the effects of cognition on the shares of investment in various assets. Additionally, after screening the data with Stata 14.0, I find that these data constitute an unbalanced short panel, which indicates a large N (number of observations) and a small T with gaps. In theory, panel data are repeated measurements at different points in time on the same individual unit (Cameron and Trivedi, 2010), N is the number of individual units observed and T means the number of time periods observed. In specific, in this chatper, N is the number of households that took part in the national survey. T is the number of the national survey binnally launched.

There are three advantages to using the HRS and ELSA data. First, the cognition of the aging group changes over time, which helps us to evaluate the effect of cognitive abilities on asset shares and the degree of portfolio diversification. Notably, cognition does not necessarily

decline over time. Although one stream of literature reports that cognitive abilities decrease among the older people (Colsher and Wallace, 1991; Evans et al., 1993; Wilson et al., 1999; Wilson et al., 2002), these authors argue that the cognitive abilities of many people decline only mildly or not at all, and may even increases mildly. Therefore, cognition could be positively or negatively time varying. Second, ELSA is comparable to HRS, which strengthens the credibility of the potential findings if I could provide consistent evidence from the two countries-survey data. Third, the questionnaires of the HRS and ELSA are generally consistent over time. Consequently, I can construct panel data to conduct a longitudinal analysis, which not only increases the accuracy of the inferences of the model parameters (Hsiao et al., 1995), but also helps to capture the complexity of human behaviours (Hsiao, 2007).

2.3.1 Measurement of cognitive abilities

For the HRS, I use a sum score that is derived by the sum of respondents' answers to a series of cognitive tasks and, ranges from 0 to 35 (Bugliari et al., 2016). A higher score means indicates better cognitive abilities. These tasks include immediate word recall (score of 0 to 10), delayed word recall (score of 0 to 10), serial 7s (score of 0 to 5), backwards counting (score of 0 to 2), naming objects (score of 0 to 2), remembering dates (score of 0 to 2), and president/vice president naming (score of 0 to 2). Christelis et al. (2010) note that the psychological literature holds that orientation, language, executive function, and memory capture the four main dimensions of cognitive abilities. Therefore, the HRS sum sore of cognition is a general indicator of cognition.

The indicator of cognition is different for the ELSA, due to gaps in data collection for certain cognitive tasks in different waves. For example, the numeracy score was collected in 2002, 2008, and 2010 but not in 2004 and 2006. To obtain an indicator that is consistent over waves, I exclude the numeracy score but include the word recall task to construct a single sum score that ranges from 0 to 20 (Phillips et al., 2017). Thus, I lose some information regarding cognitive abilities due to the use of this variable, but it captures information relating to language, executive function, and memory and thus I believe it is a valid indicator of cognition.

2.3.2 Measurement of the asset shares

To conduct an analysis of household financial portfolio choices, it is necessary to specify the asset classification scheme. Following Rosen and Wu (2004), I divide household financial assets into four types: risky assets (stocks and mutual funds), bonds (corporate, municipal and foreign bonds and bond funds), retirement account assets (IRAs and Keoghs in the US, and individual savings accounts (ISAs), tax exempt special savings accounts (TESSAs) and

personal equity plans (PEPs) in the UK) and riskless assets (checking and savings accounts, money market funds, certificate of deposit (CDs), government savings bonds, and Treasury bills). I will investigate the effect of cognitive abilities on the respective shares of investment in risk-free assets (ranging from 0 to 1), retirement account assets (ranging from 0 to 1), and risky assets (ranging from 0 to 1).

I draw your attention here to the similarities and differences in retirement saving accounts in between the US and the UK. In the US, retirement plans include IRAs and Keoghs are retirement plans in the US, which comprise financial assets and contribute to individual retirement savings. In the UK, ISAs, TESSAs and PEPs allow individuals not only to contribute to savings over the short term but also to contribute to long term-oriented retirement savings (Attanasio et al., 2004). Although there are differences among ISA, TESSA and PEP, the latter two were replaced by ISA in 1999.

Therefore, I define IRA and Keogh accounts in the US, and ISA, TESSA, and PEP accounts in the UK as the measure of household retirement savings. Although there are differences among them, such as the restriction on withdrawals from IRAs (i.e., withdrawal are permitted only after retirement). All of them are tax-free in terms of any new income or capital gains on the assets held in term (e.g., stocks, mutual funds, certificates of deposit), which helps people to accumulate private savings by increasing the net rate of return (Attanasio et al., 2004).

2.3.3 Measurement of the portfolio diversification

Following Hurd (2002), I rank asset risk from high to low. The categories are risky assets (high risk), bonds and retirement accounts (medium risk) and riskless assets (safe). I calculate the degree of portfolio diversification by summing the types of financial assets held by a household based on the four-class scheme proposed by Rosen and Wu (2004); thus, this variable ranges from 1 to 4. This measure has one limitation, which is that it is based on a strong assumption that each of the four classifications is equally weighted.

2.3.4 Control variables

The control variables I choose are conventional. First, I include age because it has an negative effect on risk aversion (Morin and Suarez, 1983; Riley and Chow, 1992; Pålsson, 1996) and a positive effect on time horizon (Cropper et al., 1994). However, people become more risk averse when they retired (Riley and Chow, 1992) and therefore I include retirement status as a binary variable.

Second, I include a binary variable to measure whether the respondent has a college education, ranging 0 to 1. The literature reports that education is a significant indicator of portfolio choice. In particular, households with higher education attainment tend to own more diversified portfolios (Goetzmann and Kumar, 2008), which may be because highly educated people can access to better information about diversified investment opportunity (King and Leape, 1998). Another reason to include education attainment is to prevent a confounding bias, because cognitive abilities are associated with education. Thus, I would like to see whether there is any variation after for controlling education.

I also include number of children, which could affect risk aversion and the decision-making time horizon, and physical health, which can also explain variances in asset holding and asset shares (Rosen and Wu, 2004; Love and Smith, 2010).

Subsequently, as income and total financial wealth are significant indicators of portfolio composition, I control for their effects by taking them into account (King and Leape, 1998). In particular, according to Chien et al. (2015), household income in US are the sum of all income from respondent and spouse's individual earning, individual income from employer pension or annuity, individual income from social security DI or SSI, individual income from social security retirement, individual unemployment or workers compensation, individual income from other government transfers and household capital income with other household income. US households' financial wealth comprise the net values of risky assets (stocks and mutual funds), IRAs (assets in IRAs and Keoghs), risk-free assets (checking and savings accounts, money market funds, CDs, government savings bonds, and Treasury), and bonds (corporate, municipal and foreign bonds, and bond funds). Similarly, according to Phillips et al. (2017), household income in UK includes components of respondent and spouse's individual earning, family capital income, individual income from employer or private pension and annuity, individual income from public pensions, individual other government transfers, and individual other regular payments. Their financial wealth are the sum of the net values of risky assets (stocks, shares, and investment funds), ISAs (ISA, PEPS, and TESSA), risk-free assets (checking and savings accounts), and bonds (bonds and bond funds). I log transform these variables to achieve normality and reduce the variability of the data.

Finally, I control for housing wealth (Chetty et al., 2017) and debt (Becker and Shabani, 2010), which are documented to influence portfolio choice. In particular, housing wealth of US households is calculated as the sum of net values of primary residence, business, vehicles, secondary home residence, other property and other physical assets after paying all mortgages/land contracts and other home loans for primary residence and secondary residence. Their debt is given by the sum of credit card balances, medical debts, life insurance policy loans,

and loans from relatives. The components that construct UK households' housing wealth are similar, only lacking the information regarding net value of vehicles. Their debt is constructed as the sum of credit card balances, loans from relatives, hire purchase agreements, personal loans, overdraft, mail order purchase agreements, DSS social fund loan or loan from a money lender. I also transform these variables into logarithm to achieve normality and reduce the variability of the data.

Controlling for these variables eliminates their potential confounding effects on household asset allocation of household, allowing for cleaner estimates of the effect of cognitive abilities. Please see more details regarding the measures of variables in Appendix A.

2.3.5 Descriptive Statistics

The descriptive statistics of all households, coupled households, and single-headed households in the US and the UK are provided in Table 2.1 and Table 2.2, respectively. Note, first, that the HRS data include a larger number of observations than the ELSA data do. Second, regarding the asset shares, the largest proportion of household financial assets are allocated to risk-free assets, accounting for approximately 55% and nearly 72% of household financial assets in the US and the UK, respectively. The second-ranked investment preferred by aging people is the retirement account, which account for approximately 20% of total financial wealth. The third-ranked asset is risky assets, which account for around 15% and 10% of total household financial assets in the US and the UK. These features indicate that people tend to keep the majority of their financial wealth in risk-free assets and distribute the remainder across different types of assets, which rank in descending order of risk level. Finally, the degree of diversification in UK households is slightly higher than that of US households; specifically, UK households tend to have more than two types of financial assets whereas US households are more likely to own fewer than two types of financial assets.

In order to unearth more information, I visualize the asset shares, diversification of financial assets, and cognitive levels, which are the key interests of the present paper. Figure 2.3 depicts changing trends in the financial wealth of US and UK households over a period of years. In average, the wealth of US households fell, whereas the wealth of UK households rose. Although the magnitude of US household financial wealth is on average larger than that of UK household financial wealth, UK household financial wealth did not suffer losses during the great recession period (2008-2010) whereas US household financial wealth decreased sharply.

Figure 2.4 and Figure 2.5 display descriptive statistics for the US sample and UK samples, respectively. The first three line diagrams show investment share in the risk-free assets, retirement account assets, and risky assets for all households over waves. The second three

linear diagrams show investment shares in risk-free assets, retirement account assets, and risky assets for all households over time for the coupled and single-headed households. The next three bar diagrams show the distribution of cognition scores across all households, coupled households, and single-headed households. The final two linear graphs plot the average values of diversification levels of financial assets for all households, coupled households, and single-headed households hold.

The fraction of US household financial assets in safe assets fluctuated slightly around 0.51 during 1995 and 2007, but dropped sharply to 0.49, on average, during the recession period (2008-2010). The average percentage of UK household investments in safe assets (36%) is much lower than that of US household (51%), which vacillated during the 2002-2010 period but did not change significantly, on average. Under the life cycle model, retirement consumption decreases with age but the elderly still need to consume for their basic life needs, and continuously to pay medical expenses to lower the risk of mortality (Hurd, 2002).

The percentage of savings in retirement accounts (5%), such as the IRAs in the US and the ISAs in the UK, experienced a smooth increase over the years, even during volatile financial period. Note that British households allocated a higher percentage of their finance wealth to retirement account (36%) compared with their American counterparts (24%) until 2010. The 12% difference may partially explain why the financial wealth of UK households has not fallen significantly whereas US households frequently suffered losses of wealth over the years. There are a number of reasons may explain. First, retirement accounts (IRAs in the US and ISAs in the UK) offer a significant tax advantage because they maximize tax-free benefits. Second, although both IRAs and ISAs can include equity funds, they are still less risky than direct individual trading and demand less focus and effort by the investor. Third, tax-deferred accounts promote increased wealth accumulation (Gomes et al., 2005).

Finally, aging cohorts in both the US and the UK reduced their investment shares in risky assets by approximately 4% during 2000-2010. In particular, UK households significantly decreased investment shares in risky assets by approximately 2.5% during the pre-recessionary period (2006-2008), which I consider a proactive move to protect against the global financial crisis. The declining trend of the percentage of stocks in household portfolio is consistent with the findings of previous studies (Cocco et al., 2005). Fagereng et al. (2017) proposed a two-fold strategy for aging households: increasingly shift the portfolio away from equity as they move toward retirement and exit the stock market after retirement. Two possible mechanisms explain the underlying rationale behind this strategy. One is that asset prices fell sharply (Meyer and Sullivan, 2013) during the great recession period and the other is that the elderly are more risk averse (Dohmen et al., 2010).

Therefore, one common feature of household portfolio choices in the two countries is that they shift their portfolios away from both risky stocks and safe assets and toward relatively safe assets (retirement account) as they age and approach retirement, which is not the same strategy suggested by the financial counselors mentioned in Cocco et al. (2005). This trend highlights the fact that retirement accounts are the choice for aging and elderly populations to maintain accumulated wealth or provide a buffer against potential negative shocks. Another common feature in the US and the UK is that even during the great recession, aging cohorts are sufficiently confident to increase the percentage of their financial wealth allocated to retirement accounts.

To summarize, based on Figure 2.3, Figure 2.4, and Figure 2.5, I consider possible reasons why American households' financial wealth declined over time, especially during the great recession (2008-2010), while British household` financial assets did not suffer losses, even during the volatile financial period. The obvious difference in portfolio structures between the two countries' relates to the percentage of financial wealth held in retirement accounts. Although I do not exclude the possibility that the macroeconomic environment and regulations in the United Kingdom protect the wealth of their citizens, allocating a higher percentage of financial wealth to retirement accounts may be one reason for the different wealth trend in the UK over the years.

Next, I examine whether cognition can explain the variance in the shift of portfolios from risky assets and safe assets to retirement accounts. If my results were significant, there may be bringing practical implications for both investor and financial institutions.

2.4 Methodology

In this section, I will discuss my methodology in two parts. In subsection 2.4.1, I provide details regarding the model specifications. In subsection 2.4.2, I introduce the method by which I split the entire sample of the US and the UK into subgroups for regression analysis.

2.4.1 Model specification

The first objective of this paper is to investigate the relationship between cognitive abilities and asset shares. Since the dependent variables are the proportions of assets in a portfolio and thus are fractional, I use a fractional response model. In the literature, Papke and Wooldridge (1996) proposes Fractional probit model, Fractional logit model, and Fractional heteroskedastic probit model for cross-sectional analysis. For fractional response variables in panel analysis, Papke and Wooldridge (2008) suggest a fractional response model for panel data. In the present paper,

I use the nonlinear model developed by Papke and Wooldridge (2008). This model is based on the generalized estimating equations (GEE) framework, which is a member of the probit family (i.e., using probit response function). I have several reasons for using this model. First, it is appropriate for estimating data with fractional dependent variables, a large cross-sectional dimension (large N), and a relatively short time horizon (small T); thus, the model fits the features of my data. Second, this model allows for unobserved heterogeneity via time-changing omitted variables, which could be associated with covariates. Third, this model provides simple estimates of average marginal effect and the results are not based no the assumption of serial dependence in the outcome variable (Papke and Wooldridge, 2008). The specific model is as follows:

$$Share(X)_{it} = Cognition_{it}\beta + X_{it}\gamma + \alpha_{it} + \delta_{it} \quad (1)$$

where $Share(X)_{it}$ is the proportion of financial assets invested in asset *X* held by household *i* in time period *t*. $Cognition_{it}$ denotes the cognitive abilities of the head of household *i* in time period t. X_{it} is a vector of variables that control for health, number of children, age, retirement status, annual household income, household financial assets, and educational attainment. α_i indicates the error term that includes all unobservable information, and δ_t indicates a vector of year dummies to control for year effect.

The second objective of this paper is to investigate the relationship between cognitive abilities and the degree of *Diversification* of the household portfolio. Since *Diversification* is intrinsically discrete and ordinal, the ordered logistic model proposed by McKelvey and Zavoina (1975) is appropriate. As the dataset is an unbalanced panel, a longitudinal analysis is necessary. Specifically, I use the ordered logistic model with fixed effect, which assumes that the individual specific effect is associated with the independent variables (Gardiner et al., 2009). One outstanding advantage of the fixed effect model is that it can control for unobservable heteroscedasticity over time and reduce the standard error (Clark and Linzer, 2015), which will yield unbiased coefficients (Fiorillo et al., 2017) and eliminate confounders. I will use the "blow-up and cluster" BUC estimators proposed by Baetschmann et al. (2015), which has been proved to be the least biased and most efficient estimator for a ordered logit model with fixed effects. The corresponding model is specified as follow:

$$Diversification_{it} = Cognition_{it}\beta + X_{it}\gamma + \alpha_{it} + \delta_{it} \quad (2)$$

Where $Diversification_{it}$ represents the level of diversification of the financial assets held by household *i* in year *t*. $Cognition_{it}$ denotes the cognitive abilities of the head of household *i* in year *t*. X_{it} is a vector of variables that control for health, number of children, age, retirement

status, annual household income, household financial assets, and educational attainment. α_i indicates the error term, which includes all unobservable information, and δ_t indicates a vector of year dummies to control for the year effect.

2.4.2 Sample split

Bogan and Fertig (2013) summarize a stream of literature and they report that coupled and single living people have different portfolio strategies (Barber and Odean, 2001; Lundberg et al., 2003; Kirchler et al., 2008; Love, 2010) because couples may engage in bargaining between two parties (Lundberg et al., 2003; Kirchler et al., 2008). Accordingly, Rosen and Wu (2004), Edwards (2008), and Love (2010) split their samples into coupled households and single-headed households because they expect that the effect of health status on household portfolios differ between these two household types. Following these studies, I decide to divide the US and UK samples into coupled households and single-headed households.

Therefore, first, I will examine the effect of cognitive abilities on investment shares in risk-free assets, IRAs, and risky assets for all households in the US, coupled households of the US, and single-headed households in the US. I also conduct an empirical test on the hypothesized relationship using the entire sample of each country. The purpose is to detect country differences in the magnitude or even the direction of the changes in asset allocation caused by cognitive abilities over time in a concise and brief manner.

Second, I will test the effect of cognitive abilities on the level of diversification of financial assets for the entire US sample, the coupled US sample, and the single-headed US sample.

I will repeat these procedures for the UK sample as a robustness check, for several reasons. First, the UK sample reason is independent of the US sample. Second, the measure of cognitive abilities used for UK sample differs from the summary cognition score used for the US sample. If I obtained results for the UK sample that are similar to the results for the US sample, I will strengthen the credibility of my findings and permit their generalization to a wider context.

2.4.3 Standardizing key variables of interest

Since some hypotheses aim to test the moderating effect of financial wealth on the relationship between cognition and the proportion of investment in different financial assets, I make the z-score transformation for cognition and log (financial wealth). It is one of two ways that can address collinearity issues when an interaction term is constructed from two continuous variables (Mehmetoglu and Jakobsen, 2016). The corresponding estimates are interpreted in terms of standard deviation.

Table 2.1 reports summary statistics for the US sample. The data source is eight periods of national cross-sectional data from the US Health and Retirement Survey from 1996 to 2010. There are three panels, which describe the dependent variables, independent variable, and control variables in terms of observations, means, standard errors, minimums, and maximums. Inflation has been taken into account by multiplying values of the OECD consumer price index. All statistics are calculated for the entire sample, the coupled sample, and the single-headed sample.

	All households (1)					Coupled households (2)					Single-headed households (3)				
Variables	**Observations**	**Mean**	**Standard Error**	**Min**	**Max**	**Observations**	**Mean**	**Standard Error**	**Min**	**Max**	**Observations**	**Mean**	**Standard Error**	**Min**	**Max**
Panel A: Dependent variables															
Share of risky assets	82,953	0.151	0.281	0	1	43,275	0.168	0.284	0	1	39,678	0.132	0.277	0	1
Share of assets in IRAs	82,953	0.204	0.323	0	1	43,275	0.269	0.347	0	1	39,678	0.134	0.279	0	1
Share of risk-free assets	82,953	0.638	0.407	0	1	43,275	0.543	0.408	0	1	39,678	0.720	0.385	0	1
Diversification of financial assets	82,953	1.754	0.894	1	4	43,275	1.944	0.934	1	4	39,678	1.546	0.798	1	4
Panel B: Independent variable															
Cognition	59,116	22.982	5.016	0	35	30,365	24.410	4.195	0	35	28,751	21.474	5.359	0	35
Panel C: Control variables															
Log(Financial wealth)	82,953	8.441	4.401	0	17.846	43,275	10.645	2.453	0	17.657	39,678	9.403	2.771	0	17.846
Log(Household income)	82,953	10.303	1.439	0	17.923	43,275	10.303	1.439	0	17.127	39,678	10.013	1.187	0	16.009
Log(Housing wealth)	82,953	10.532	3.563	0	18.212	43,275	11.734	1.957	0	18,212	39,678	9.221	4.366	0	17.518
Log(debt)	82,953	2.467	3.775	0	16.003	43,275	2.730	3.955	0	16.003	39,678	2.180	3.546	0	14.683
Age/10	82,953	6.962	1.080	5	10.9	43,275	6.962	1.080	5	10	39,678	7.238	1.127	5	10.7
Number of children	81,709	3.125	2.196	0	22	42,785	3.125	2.196	0	21	38,924	2.691	2.075	0	20
Chronic diseases	82,953	1.871	1.360	0	7	43,275	1.871	1.360	0	7	39,678	1.954	1.352	0	7
Retired (%)	83,744	0.542	0.498	0	1	43,275	0.542	0.498	0	1	39,999	0.560	0.496	0	1
College (%)	82,937	0.431	0.495	0	1	43,263	0.431	0.495	0	1	39,674	0.381	0.485	0	1
Year1996 (%)	82,953	0.114	0.318	0	1	43,275	0.114	0.318	0	1	39,678	0.106	0.308	0	1
Year1998 (%)	82,953	0.136	0.342	0	1	43,275	0.136	0.342	0	1	39,678	0.129	0.335	0	1
Year2000 (%)	82,953	0.128	0.335	0	1	43,275	0.128	0.335	0	1	39,678	0.126	0.332	0	1
Year2002 (%)	82,953	0.123	0.329	0	1	43,275	0.123	0.329	0	1	39,678	0.126	0.332	0	1
Year2004 (%)	82,953	0.131	0.337	0	1	43,275	0.131	0.337	0	1	39,678	0.130	0.336	0	1
Year2006 (%)	82,953	0.123	0.329	0	1	43.275	0.123	0.329	0	1	39,678	0.127	0.333	0	1
Year2008 (%)	82,953	0.115	0.319	0	1	43,275	0.115	0.319	0	1	39,678	0.123	0.328	0	1
Year2010 (%)	82,953	0.128	0.334	0	1	43,275	0.128	0.334	0	1	39,678	0.133	0.339	0	1

(a) Financial wealth, household income, housing wealth and debt are in USD and have been inflated using the 2010-base OECD consumer price index;

(b) Financial assets include risky assets (stocks and mutual funds), IRA assets (IRAs and Keogh accounts), risk-free assets (checking and savings accounts, money market funds, CDs, government savings bonds and treasury bills), and bonds (corporate, municipal and foreign bonds and bond funds). The share of risky assets indicates the proportion of total financial assets invested in risky assets. The share of IRAs indicates the proportion of total financial assets invested in IRAs. The share of risk-free assets means the proportion of total financial assets invested in risk-free assets. The diversification of financial assets is the sum score of the types of assets held by household and ranges from 0 to 4.

(c) Cognition is a sum score obtained from the Health and Retirement Survey that is calculated as the sum of respondents` answers to a series of cognitive tasks; the score arranges from 0 to 35. A higher score indicates better cognition abilities.

(d) Source: US Health and Retirement Survey, eight waves since 1996.

Table 2.2 reports summary statistics for the UK sample. The data source is five periods of national cross-sectional data from the UK English Longitudinal Survey of Aging from 2002 to 2010. There are three panels, which describe the dependent variables, the independent variables, and the control variables, in terms of observations, means, standard errors, minimums, and maximums. The inflation and exchange rates have been taken into account by multiplying values of the OECD consumer price index and the OECD purchasing power parity. All statistics are calculated for the entire sample, the coupled sample, and the single-headed sample.

	All households (1)					Coupled households (2)					Single-headed households (3)				
Variables	**Observations**	**Mean**	**Standard Error**	**Min**	**Max**	**Observations**	**Mean**	**Standard Error**	**Min**	**Max**	**Observations**	**Mean**	**Standard Error**	**Min**	**Max**
Panel A: Dependent variables															
Share of risky assets	28,873	0.103	0.217	0	1	16,217	0.120	0.225	0	1	12,656	0.082	0.205	0	1
Share of assets in ISAs	28,873	0.204	0.309	0	1	16,217	0.291	0.308	0	1	12,656	0.216	0.306	0	1
Share of risk-free assets	28,873	0.638	0.382	0	1	16,217	0.501	0.366	0	1	12,656	0.630	0.386	0	1
Diversification of financial assets	28,873	2.280	1.128	1	4	16,217	2,498	1.146	1	4	12,656	1.994	1.035	1	4
Panel B: Independent variable															
Cognition (Tr20)	28,675	10.798	3.715	0	20	16,184	12.011	3.082	0	20	12,491	9.226	3.873	0	20
Panel C: Control variables															
Log(Financial wealth)	29,014	8.441	2.263	0.36	16.323	16,237	10.324	2.037	0.36	16.322	12,777	9.207	2.379	0.36	15.685
Log(Household income)	28,856	10.303	0.861	0.36	14.334	16,209	10.540	0.674	0.48	14.334	12,647	9.739	0.865	0.36	13.742
Log(Housing wealth)	29,014	10.276	4.888	0.36	17.940	16,237	11.596	3.703	0.36	17.427	12,777	1.978	2.921	0.36	17.941
Log(debt)	28,873	2.530	3.406	0.36	12.630	16,217	2.960	3.684	0.36	12.631	12,656	1.978	2.921	0.36	11.910
Age/10	29,014	6.962	1.027	5	9	16,237	6.517	0.904	5.1	9	12,777	7.070	1.089	5	9
Number of children	29,014	3.125	1.501	0	16	16,237	2.311	1.432	0	14	12,777	1.786	1.534	0	16
Chronic diseases	29,014	1.871	1.146	0	7	16,237	1.148	1.110	0	6	12,777	1.440	1.169	0	7
Retired	29,034	0.542	0.493	0	1	16,244	0.520	0.500	0	1	12,790	0.669	0.470	0	1
College	26,934	0.431	0.479	0	1	14,941	0.436	0.496	0	1	11,993	0.256	0.436	0	1
Year2002	29,014	0.230	0.421	0	1	16,237	0.225	0.418	0	1	12,777	0.235	0.424	0	1
Year2004	29,014	0.181	0.385	0	1	16,237	0.179	0.384	0	1	12,777	0.183	0.386	0	1
Year2006	29,014	0.182	0.385	0	1	16,237	0.180	0.384	0	1	12,777	0.184	0.387	0	1
Year2008	29,014	0.209	0.406	0	1	16,237	0.213	0.409	0	1	12,777	0.203	0.403	0	1
Year2010	29,014	0.199	0.399	0	1	16,237	0.203	0.402	0	1	12,777	0.195	0.396	0	1

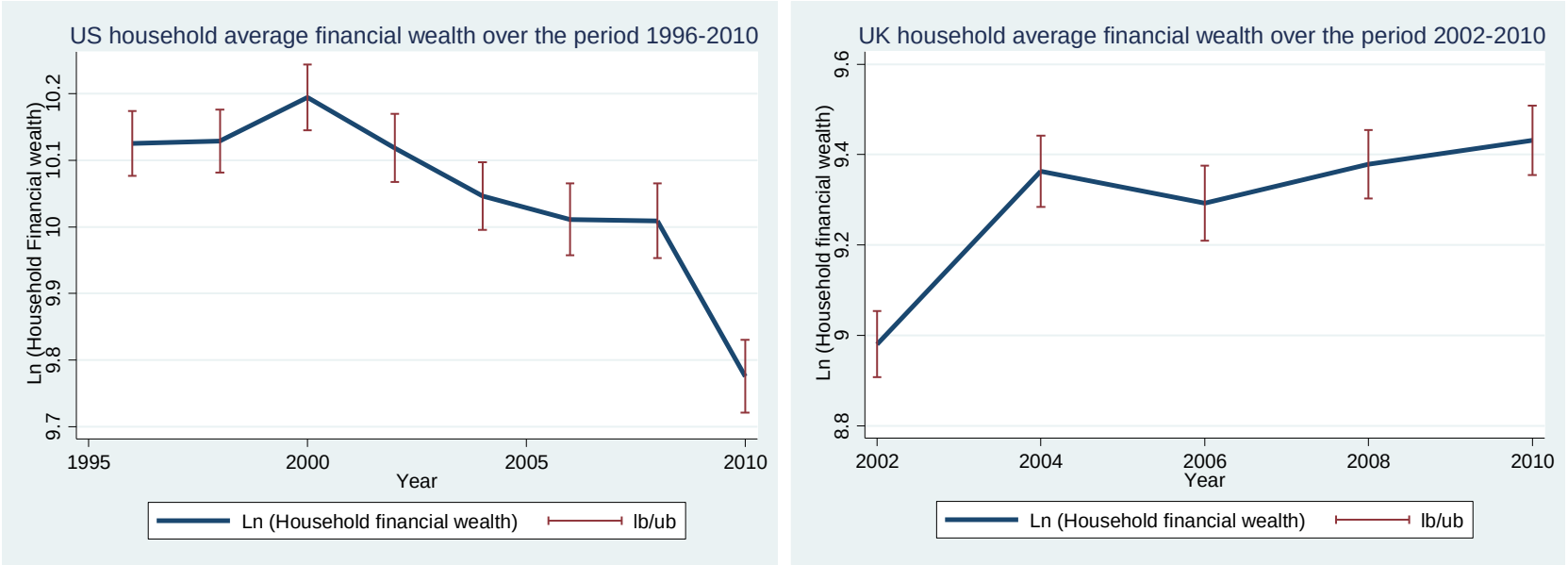
(a) Financial wealth, household income, housing wealth and debt are in USD, and have been inflated using the 2010-base OECD consumer price index and OECD purchasing power party;

(b) Financial assets include risky assets (stocks and mutual funds), ISA assets (ISAs, PEPs and TESSAs), risk-free assets (Checking and savings accounts, money market funds, CDs, government savings bonds and treasury bills), and bonds (corporate, municipal and foreign bonds and bond funds). The share of risky assets indicates the proportion of total financial assets invested in risky assets. The share of ISAs indicates the proportion of total financial assets invested in the individual savings accounts. The share of risk-free assets indicates the proportion of total financial assets invested in risk-free assets. The diversification of financial assets is the sum score of the types of assets held by a household and ranges from 0 to 4.

(c) Cognition (Tr20) is a sum score obtained from English Longitudinal Survey of Aging by summing respondents` answers to work recall tasks; the score ranges from 0 to 20. A higher score means better cognition abilities

(d) Source: UK English Longitudinal Survey of Aging, five waves since 2002.

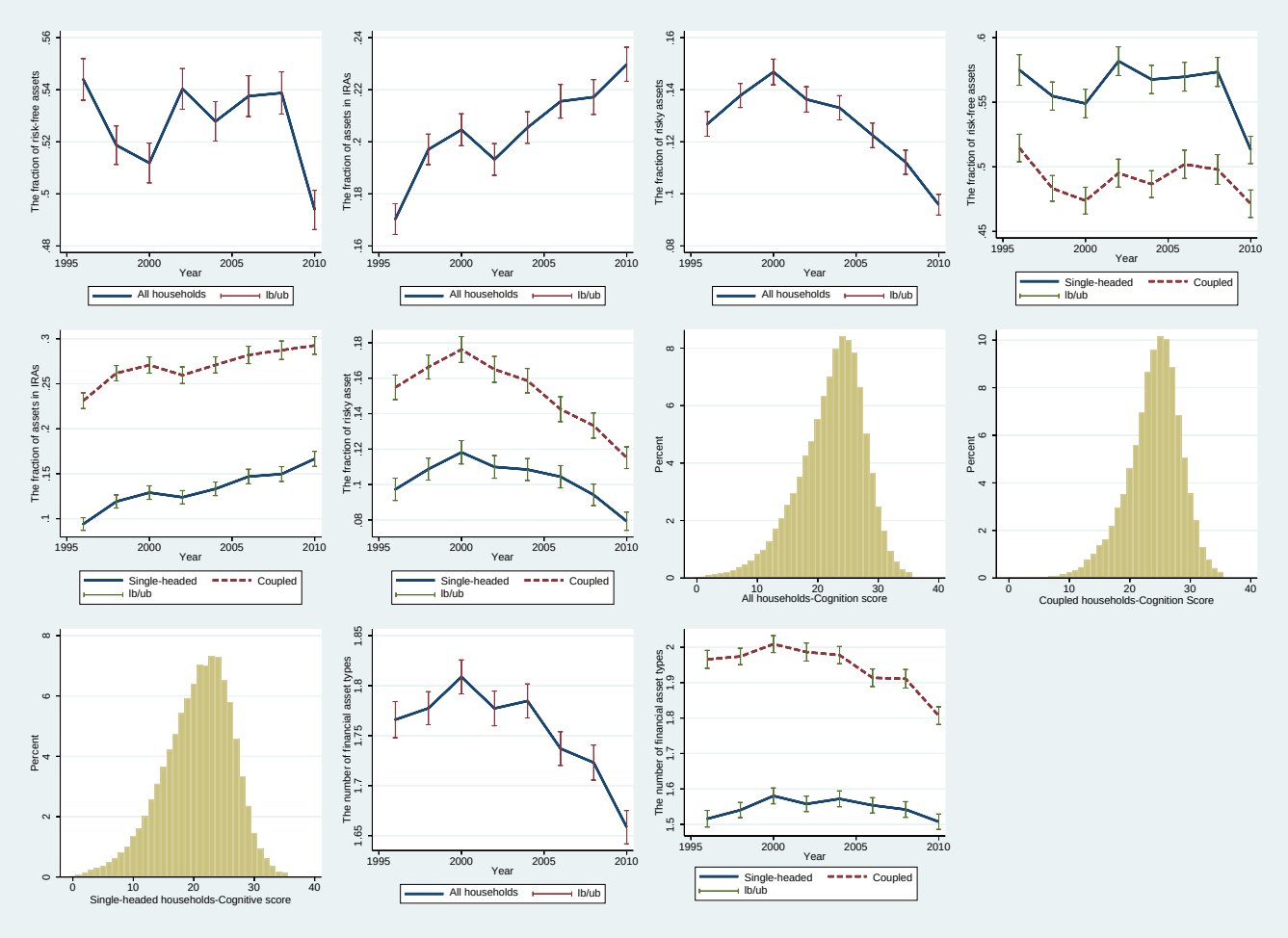
Figure 2.3 illustrates average financial wealth in logarithm form of US and UK households. One data source includes eight waves of national cross-sectional data from the US Health and Retirement Survey from 1996 to 2010. The other data source includes five periods of national cross-sectional data from the UK English Longitudinal Survey of Aging from 2002 to 2010. Two line diagrams depict changing trend of financial wealth of US and UK households.



Note:

a) Financial wealth and household income are in USD and have been inflated using the 2010-base OECD consumer price index;
b) Source: US Health and Retirement Survey, eight biennial waves from 1996 to 2010.
c) Source: UK English Longitudinal Survey of Aging, five biennial waves from 2002 to 2010.

Figure 2.4 illustrates descriptive statistics for the US sample. The data source is eight periods of national cross-sectional data from the US Health and Retirement Survey from 1996 to 2010. The first three line diagrams report the investment shares in risk-free assets, IRA assets, and in the risky assets over waves for all households. The second three linear diagrams report investment shares in risk-free assets, IRA assets, and risky assets over time for the coupled and single-headed households. The next three bar diagrams show the distribution of cognition scores for all households, coupled households, and single-headed households. The final two linear graphs plot the average values of the diversification levels of financial assets held by all households, coupled households, and single-headed households.



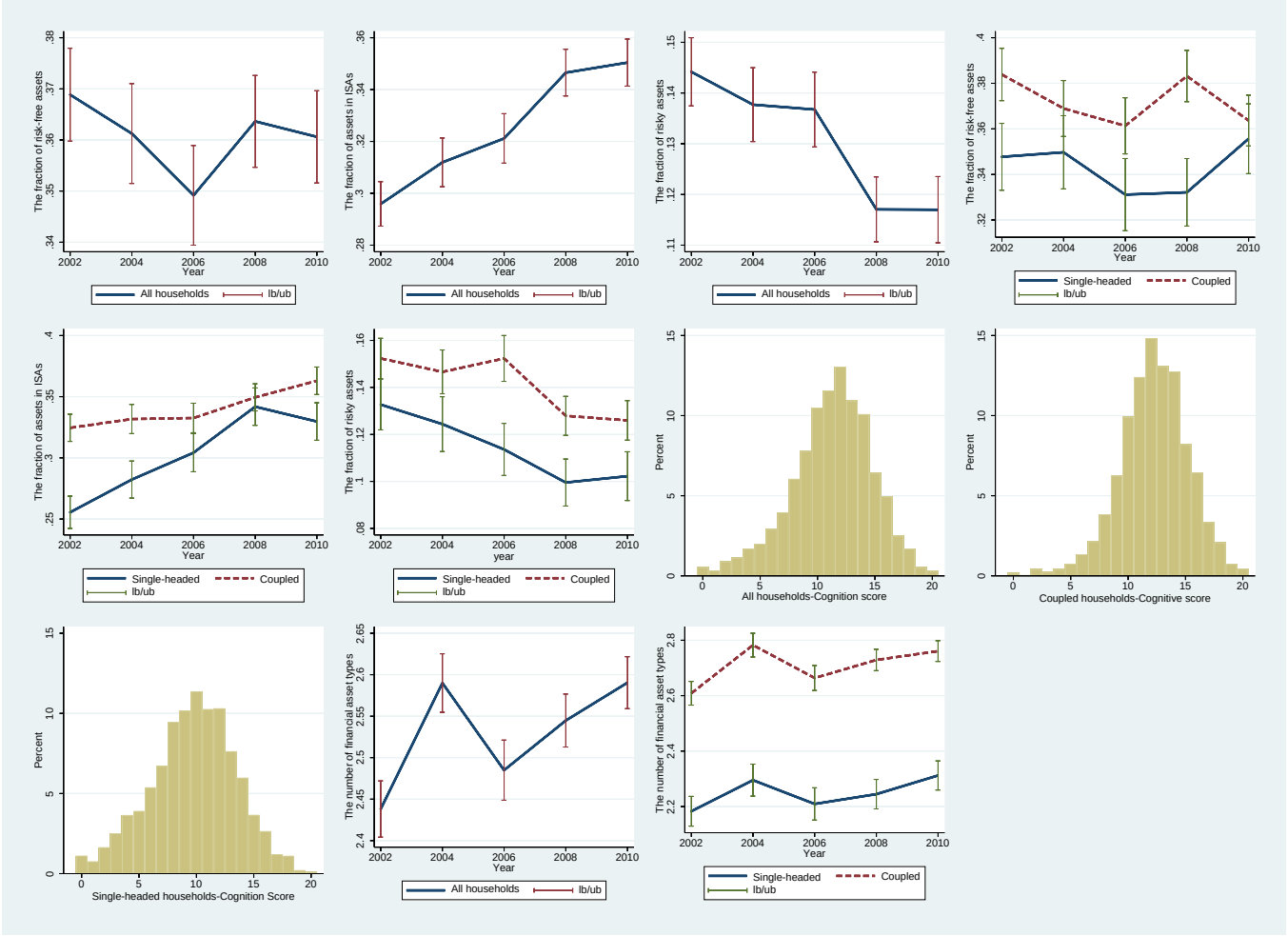
a) Financial wealth and household income are in USD, and have been inflated using 2010-base OECD consumer price index.

b) Financial assets include risky assets (stocks and mutual funds), IRA assets (IRAs and Keogh accounts), risk-free assets (checking and savings accounts, money market funds, CDs, government savings bonds and treasury bills), and bonds (corporate, municipal and foreign bonds and bond funds). The share of risky assets indicates the proportion of total financial assets invested in risky assets. The share of IRA indicates the proportion of total financial assets invested in IRAs. The share of risk-free assets indicates the proportion of total financial assets invested in risk-free assets. Diversification of financial assets is the sum score of the types of assets held by one household has, ranging from 0 to 4.

c) Cognition is a sum score obtained from the Health and Retirement Survey achieved by summing respondents' answers to a series of cognitive tasks and ranges from 0 to 35. A higher score indicates better cognitive abilities.

d) Source: US Health and Retirement Survey, eight waves since 1996.

Figure 2.5 illustrates descriptive statistics for the UK sample. The data source is five periods of national cross-sectional data from the UK English Longitudinal Survey of Aging from 2002 to 2010. The first three line diagrams report investment shares in risk-free assets, ISA assets, and risky assets for all households over waves. The second three linear diagrams report investment shares in risk-free assets, ISA assets, and risky assets over time for coupled and single-headed households. The next three bar diagrams show the distribution of cognition scores for all households, coupled households, and single-headed households. The final two line graphs plot the average values of the levels of financial assets diversification for all households, coupled households, and single-headed households.



(a) Financial wealth and household income are in USD, and have been inflated using the 2010-base OECD consumer price index and OECD purchasing power party;

(b) Financial assets include risky assets (stocks and mutual funds), ISA assets (ISAs, PEPs and TESSAs), risk-free assets (Checking and savings accounts, money market funds, CDs, government savings bonds and Treaury bills), and bonds (corporate, municipal and foreign bonds and bond funds). The share of risky assets indicates the proportion of total financial assets invested in risky assets. The share of ISA indicates the proportion of total financial assets invested in individual saving accounts. The share of risk-free assets means the proportion of total financial assets invested in risk-free assets. Diversification of financial assets is the sum score of the types of assets held by a household and ranges from 0 to 4.

(c) Cognition (Tr20) is a sum score obtained from the English Longitudinal Survey of Aging by the summing of respondents' answers to work recall tasks; the score ranges from 0 to 20. A higher score indicates better cognitive abilities.

(d) Source: UK English Longitudinal Survey of Aging, five waves since 2002.

2.5 Results

2.5.1 Cognitive abilities and asset allocations

Below, I report the empirical results for the US and the UK regarding the relationship between cognitive capabilities and investment shares in risk-free assets, retirement accounts, and risky assets.

2.5.1.1 Cognitive abilities and the share of investment in riskless assets

Table 2.3 and Table 2.4, respectively, show the effect of cognitive skills on the proportion of financial assets invested in risk-free assets for US household and UK households. These tables reveal the average marginal results from the GEE population-averaged model with time dummies. Results are estimated by robust standard errors clustered at the household level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively. I control for demographic information, wealth, and physical health, as well as for economic trends using year dummies. Particularly, Column (1) reports the results without interaction items, and Column (2) reports the results with interaction items.

Particularly, according to Table 2.3, the first intuitive finding is that in US households, cognitive abilities are negatively associated with the share of financial assets invested in the risk-free assets. In other words, heads of the households with higher cognitive abilities are more comfortable to owning a smaller share of risk-free assets relative to their entire financial wealth, which supports *hypothesis a1*. This finding is supported by the consistently significant results across different subgroups of the US sample. For each standard deviation unit increase in cognition score (standardized), the proportion of financial assets invested in risk-free assets decreases by around 0.010. The second finding is that compared with single-headed households, the magnitude of the effect of cognitive abilities on the share of financial assets invested in risk-free assets is larger in the coupled households, which is suggested by the fact that the sign of the coefficient of interaction term between *cognition* and *the coupled household* is significantly negative. In other words, the coupled households accelerate the adverse effect of cognitive abilities on the share of financial assets invested in risk-free assets, which supports *hypothesis a2*. To visualize this interaction effect, I present Figure 2.6, in which the x-axis is the cognition score and the y-axis is the share of financial assets invested in risk-free assets. Blue solid line represents single-headed households, and the red dashed line represents coupled households. From the directions of these two lines, it shows that cognitive abilities have a negative effect on the share of financial assets invested in the risk-free assets. Regarding the slopes of the two lines, the slope for coupled households is steeper than that for the single-headed households.

Third, the coefficients of interaction items between cognitive abilities and the value of financial assets are not consistently significant in the US sample, which indicates a lack of empirical support for *hypothesis a3*.

Table 2.4 shows that cognitive abilities are negatively associated with the share of financial assets invested in risk-free assets in UK households. In other words, heads of households with higher cognitive abilities tend to have a smaller share of financial assets in riskless assets on average, which also supports *hypothesis a1*. This result is consistently significant across different subgroups of the UK sample. For each standard deviation unit increase in cognition score (standardized), the proportion of financial assets invested in risk-free assets decreases by around 0.022. The second finding is that the magnitude of the effect of cognitive abilities on the share of financial assets invested in risk-free assets is larger in single-headed households than in coupled households, as reflected by the significantly positive sign of the coefficient on interaction term between *Cognition* and *The coupled household*. In other words, the presence of a coupled household weakens the negative effect of cognitive abilities on the share of financial assets invested in risk-free assets, which supports *hypothesis a2* but the direction of this moderation effect is opposite for in US sample. To visualize this interaction effect, I present Figure 2.7 in which the x-axis is the cognition score and the y-axis is the share of financial assets invested in the risk-free assets. The blue solid line represents single-headed households while the red solid line represents coupled households. The direction of the two lines indicates that the effect of cognitive abilities is negative relative to the fraction of financial assets invested in risk-free assets. The slope of the single-headed households line is steeper than that of coupled households. The third finding is that the coefficients of the interaction term between cognitive abilities and the value of financial assets are consistently significant in the UK sample, which indicates empirical support for *hypothesis a3*. I present Figure 2.8 to illustrate these results; the *x*-axis represents cognition abilities, and the *y*-axis is the proportion of financial assets invested in risk-free assets. Lines with different colors represent different levels of financial wealth. It is remarkable that the adverse effect of cognitive abilities on the share of financial assets invested in the risk-free assets weakens as the wealth of UK households increase. The empirical results support *hypothesis a1* in both the US and the UK. The results also support *Hypothesis a2*, although moderation effect of gender composition goes in the opposite direction in the US and the UK, is opposite. *Hypothesis a3* is supported only by the UK sample.

Table 2.3 reports the effect of cognition abilities on the fraction of financial assets invested in risk-free assets among US households.

The fraction of the investment in risk-free asset held by US households

Variables	All households	All households	Coupled households	Coupled households	Single-headed households	Single-headed households
	(1)	(2)	(1)	(2)	(1)	(2)
Main effect						
Cognition	-0.009***	-0.010***	-0.010***	-0.011***	-0.007***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Control effect						
Age	0.046***	0.047***	0.059**	0.059***	0.036***	0.036***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.006)	(0.006)
Retired	0.005	0.004	0.002	0.003	0.005	0.005
	(0.007)	(0.006)	(0.005)	(0.005)	(0.010)	(0.010)
Number of Children	-0.001	-0.001	-0.003**	-0.003**	0.001	0.001
	(0.002)	(0.002)	(0.001)	(0.001)	(0.003)	(0.003)
Physical	-0.002	-0.002	-0.001	-0.001	-0.003	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)
Log (Household Income)	0.011***	0.012***	0.022***	0.022***	0.006	0.006
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Log (Financial wealth)	-0.257***	-0.258***	-0.271***	-0.272***	-0.230***	-0.230***
	(0.006)	(0.006)	(0.003)	(0.003)	(0.011)	(0.011)
Log (Housing wealth)	-0.004***	-0.004***	-0.003***	-0.006***	-0.003***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log (debt)	-0.004***	-0.004***	-0.003***	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.011)	(0.011)
College	-0.064***	-0.063***	-0.062***	-0.062***	-0.071***	-0.071***
	(0.008)	(0.006)	(0.006)	(0.006)	(0.015)	(0.015)
Male	-0.008	-0.006			-0.005	-0.005
	(0.012)	(0.011)			(0.011)	(0.011)
Year1998	-0.017***	-0.017***	-0.019***	-0.018***	-0.015***	-0.015***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Year2000	-0.025***	-0.026***	-0.023***	-0.023***	-0.029***	-0.029**
	(0.005)	(0.004)	(0.006)	(0.006)	(0.006)	(0.006)
Year2002	-0.010*	-0.011**	-0.009*	-0.008	-0.011	-0.010
	(0.006)	(0.005)	(0.006)	(0.006)	(0.012)	(0.012)
Year2004	-0.017*	-0.018***	-0.016***	-0.016***	-0.018	-0.018
	(0.006)	(0.006)	(0.005)	(0.005)	(0.013)	(0.013)
Year2006	-0.020***	-0.021***	-0.009	-0.009	-0.032***	-0.032***
	(0.007)	(0.006)	(0.006)	(0.006)	(0.011)	(0.011)
Year2008	-0.014	-0.015*	-0.010*	-0.010	-0.019	-0.019
	(0.009)	(0.009)	(0.006)	(0.006)	(0.016)	(0.016)
Year2010	-0.030***	-0.032***	-0.021***	-0.020***	-0.043***	-0.043***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.010)	(0.010)
Coupled household	-0.032***	-0.033***				
	(0.006)	(0.006)				
Interaction effect						
*Cognition*Log(Financial asset)*		-0.018**		-0.027**		0.005
		(0.001)		(0.010)		(0.013)
*Cognition*Coupled households*		-0.030***				
		(0.002)				
Observations	58,083	58,083	29,943	29,943	28,140	28,140
Number of Households	17,393	17,393	10,045	10,045	10,013	10,013

Note: This table illustrates the estimation results of the GEE population-averaged model with time dummies. The average marginal effect is estimated with robust standard errors clustered at the household level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Other effects, including those of demographic factors, wealth, and physical health are controlled for. Column (1) reports the results without interaction items and Column (2) reports the results with interaction items.

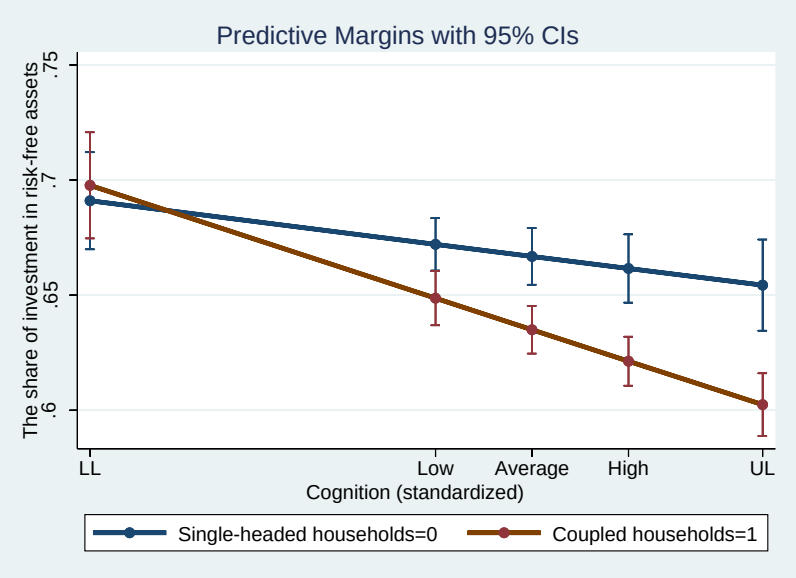
Table 2.4 reports the effect of cognition abilities on the fraction of investments in risk-free assets among UK households**.**

The fraction of the investment in risk-free asset held by the UK households

Variables	All households (1)	All households (2)	Coupled households (1)	Coupled households (2)	Single-headed households (1)	Single-headed households (2)
Main effect						
Cognition (Tr20)	-0.025***	-0.023***	-0.017***	-0.017***	-0.028***	-0.029***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Control effect						
Age	0.018***	0.017***	0.002	0.003	0.028***	0.028***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Retired	-0.030***	-0.031***	-0.028***	-0.029***	-0.024***	-0.027***
	(0.006)	(0.006)	(0.008)	(0.008)	(0.009)	(0.009)
Number of Children	-0.001	0.001	-0.001	-0.001	0.001	0.001
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Physical	0.008***	0.008***	0.012***	0.012***	0.003	0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Log (Household Income)	-0.005***	-0.006**	-0.008*	-0.009*	-0.004	-0.005
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Log (Financial wealth)	-0.136***	-0.136***	-0.113***	-0.112***	-0.158***	-0.161***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.007)	(0.007)
Log (Housing wealth)	-0.010***	-0.010***	-0.011***	-0.011***	-0.009***	-0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log (debt)	-0.003***	-0.002***	-0.002**	-0.002*	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
College	-0.031***	-0.033***	-0.027***	-0.028***	-0.041***	-0.040***
	(0.006)	(0.006)	(0.008)	(0.008)	(0.010)	(0.010)
Male	0.048***	0.044***			0.048***	0.050***
	(0.006)	(0.010)			(0.009)	(0.010)
Year2004	-0.007	-0.007	-0.008	-0.008	-0.006	-0.005
	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)	(0.008)
Year2006	-0.015***	-0.016***	-0.015**	-0.016**	-0.016*	-0.016*
	(0.005)	(0.006)	(0.007)	(0.007)	(0.008)	(0.008)
Year2008	-0.015***	-0.016***	-0.004	-0.005	-0.029***	-0.029***
	(0.006)	(0.006)	(0.008)	(0.008)	(0.009)	(0.009)
Year2010	-0.032***	-0.032***	-0.028***	-0.028***	-0.034***	-0.033***
	(0.006)	(0.006)	(0.008)	(0.008)	(0.009)	(0.009)
Coupled household	-0.027**	-0.027**				
	(0.009)	(0.009)				
Interaction effect						
*Cognition*Log(Financial asset)*		0.063***		0.039***		0.061***
		(0.011)		(0.013)		(0.016)
*Cognition*Coupled households*		0.043***				
		(0.015)				
Observations	26,517	26,517	14,857	14,857	11,660	11,660
Number of Households	8,738	8,738	4,942	4,942	3,982	3,982

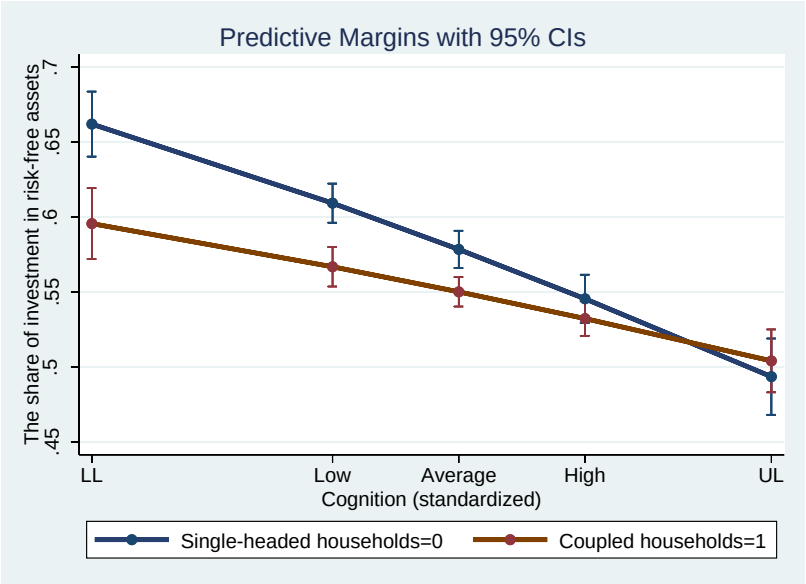
Note: This table illustrates the estimation results of GEE population-averaged model with time dummies. The average marginal effect is estimated with robust standard errors clustered at the household level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Other effects, including those of demographic factors, wealth, and physical health, are controlled for. Column (1) reports the results without interaction items, and Column (2) reports the results with interaction items.

Figure 2.6 illustrates how the gender composition of US households moderates the relationship between cognitive score and the fraction of total financial assets invested in risk-free assets. The *x*-axis represents cognitive abilities, and the *y*-axis represents the fraction of total financial assets invested in risk-free assets. The blue solid line represents single-headed households, and the red solid line represents coupled households.



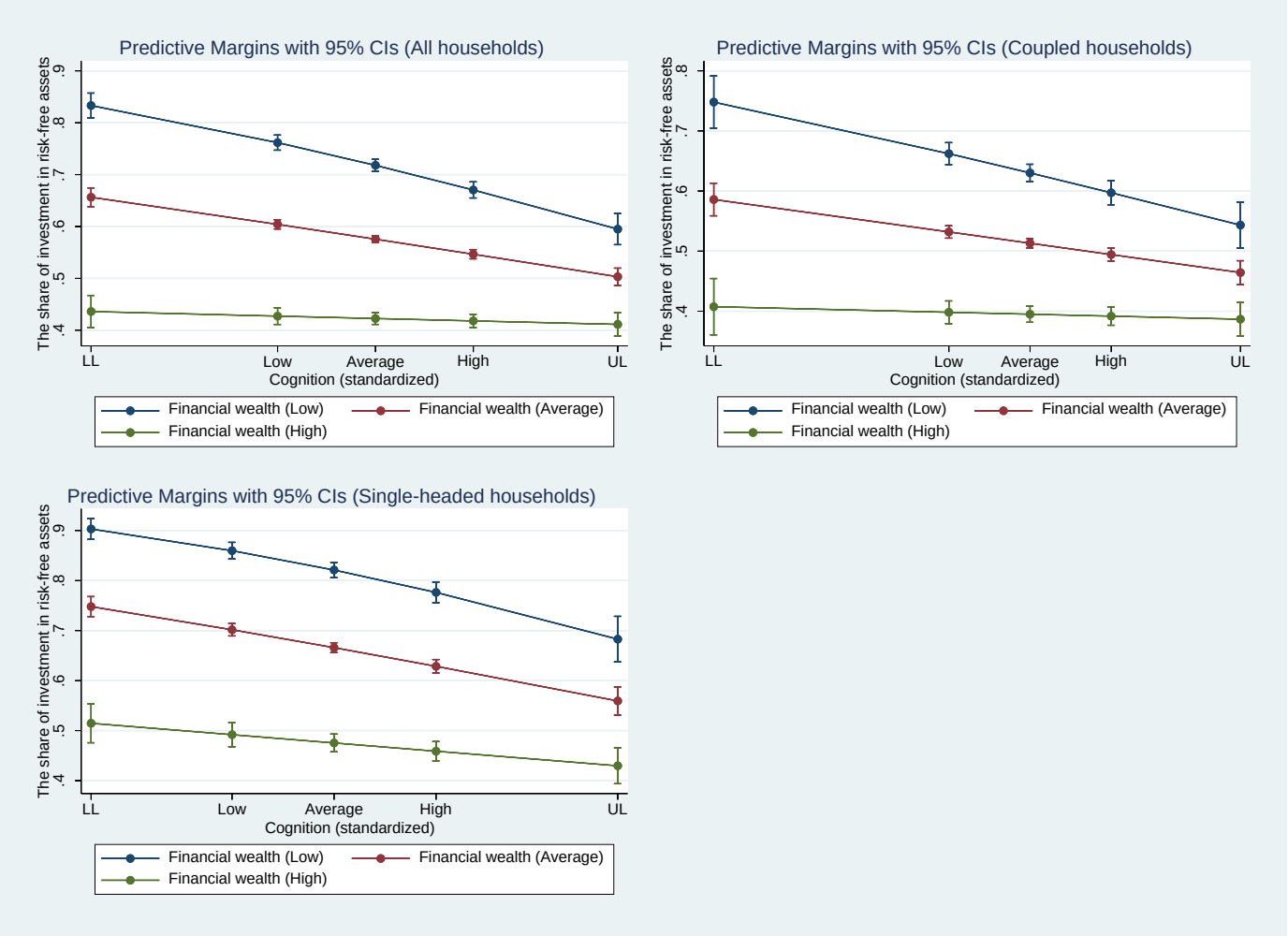
Moderator: household composition	Average marginal effect	SD	Z	P>|Z|
Single-headed households	-0.005**	0.002	-2.11	0.034
Coupled households	-0.014***	0.002	-6.19	0.000

Figure 2.7 illustrates how the gender composition of UK households moderates the relationship between the cognitive score and the fraction of total financial assets invested in risk-free assets. The *x*-axis represents cognitive abilities, and the *y*-axis represents the fraction of total financial assets invested in risk-free assets. The blue solid line represents single-headed households, and the red solid line represents coupled households.



Moderator: household composition	Average marginal effect	SD	Z	P>|Z|
Single-headed households	-0.031***	0.004	-8.14	0.000
Coupled households	-0.017***	0.004	-4.47	0.000

Figure 2.8 illustrates how wealth of UK households moderates the relationship between cognitive score and the fraction of total financial assets invested in risk-free assets. The *x*-axis represents cognitive abilities, and the *y*-axis represents the fraction of total financial assets invested in risk-free assets. Lines of different colours represents different levels of financial wealth.



UK households (all)

Moderator: Financial wealth	Average marginal effect	SD	Z	P>|Z|
Low (-1 SD from mean)	-0.045***	0.005	-9.08	0.000
Average (0 SD from mean)	-0.028***	0.003	-9.27	0.000
High (+1 SD from mean)	-0.005	0.005	-1.00	0.316

UK households (coupled)

Moderator: Financial wealth	Average marginal effect	SD	Z	P>|Z|
Low (-1 SD from mean)	-0.032***	0.006	-5.04	0.000
Average (0 SD from mean)	-0.019***	0.003	-5.37	0.000
High (+1 SD from mean)	-0.003	0.005	-0.59	0.615

UK households (single-headed)

Moderator: Financial wealth	Average marginal effect	SD	Z	P>|Z|
Low (-1 SD from mean)	-0.041***	0.006	-7.35	0.000
Average (0 SD from mean)	-0.036***	0.004	-8.40	0.000
High (+1 SD from mean)	-0.016**	0.007	-2.50	0.012

Table 2.5 reports the effect of cognitive abilities on the fraction of total household investments allocated to IRA accounts among US households.

The fraction of total investments in IRA accounts among US households

Variables	All households (1)	All households (2)	Coupled Households (1)	Coupled Households (2)	Single-headed households (1)	Single-headed households (2)
Main effect						
Cognition	0.007***	0.006***	0.006***	0.006***	0.006***	0.005***
	(0.006)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Control effect						
Age	-0.065***	-0.065***	-0.074***	-0.075***	-0.055***	-0.055***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Retired	0.010***	0.010***	0.010**	0.010**	0.008**	0.008**
	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)	(0.004)
Number of Children	0.002*	0.002*	0.002	0.002	0.002	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Physical	0.001	0.001	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Log (Household Income)	-0.021***	-0.021***	-0.034***	-0.033***	-0.011***	-0.011***
	(0.001)	(0.001)	(0.003)	(0.003)	(0.001)	(0.001)
Log (Financial wealth)	0.120***	0.119***	0.141***	0.140***	0.089***	0.088***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)
Log (Housing wealth)	0.005***	0.005***	0.007***	0.007***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log (debt)	0.001***	0.001***	0.002***	0.002***	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
College	0.015***	0.015***	0.018***	0.018***	0.014**	0.014**
	(0.004)	(0.004)	(0.006)	(0.006)	(0.006)	(0.006)
Male	0.007	0.007			0.001	0.001
	(0.006)	(0.006)			(0.005)	(0.005)
Year1998	0.017***	0.018***	0.018***	0.018***	0.016***	0.016***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)	(0.004)
Year2000	0.027***	0.027***	0.026***	0.027***	0.024***	0.024***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)	(0.005)
Year2002	0.025***	0.025***	0.022***	0.023***	0.025***	0.025***
	(0.004)	(0.004)	(0.006)	(0.006)	(0.005)	(0.005)
Year2004	0.030***	0.030***	0.029***	0.029***	0.030***	0.030***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Year2006	0.044***	0.044***	0.044***	0.044***	0.043***	0.043***
	(0.004)	(0.004)	(0.006)	(0.006)	(0.006)	(0.006)
Year2008	0.053***	0.053***	0.053***	0.054***	0.051***	0.051***
	(0.004)	(0.004)	(0.006)	(0.006)	(0.006)	(0.006)
Year2010	0.067***	0.067***	0.066***	0.067***	0.067***	0.067***
	(0.004)	(0.004)	(0.006)	(0.006)	(0.005)	(0.006)
Coupled household	0.043***	0.043***				
	(0.005)	(0.005)				
Interaction effect						
*Cognition*Log(Financial asset)*		-0.026***		-0.025***		-0.023**
		(0.007)		(0.008)		(0.012)
*Cognition*Coupled households*		0.002				
		(0.012)				
Observations	58,083	58,083	29,943	29,943	28,140	28,140
Number of Households	17,393	17,393	10,045	10,045	10,013	10,013

Note: This table illustrates the estimation results of the GEE population-averaged model with time dummies. The average marginal effect is estimated with robust standard errors clustered at the household level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Other effects, including those of demographic factors, wealth, and physical health, are controlled for. Column (1) reports the results without interaction items, and Column (2) reports the results with interaction items.

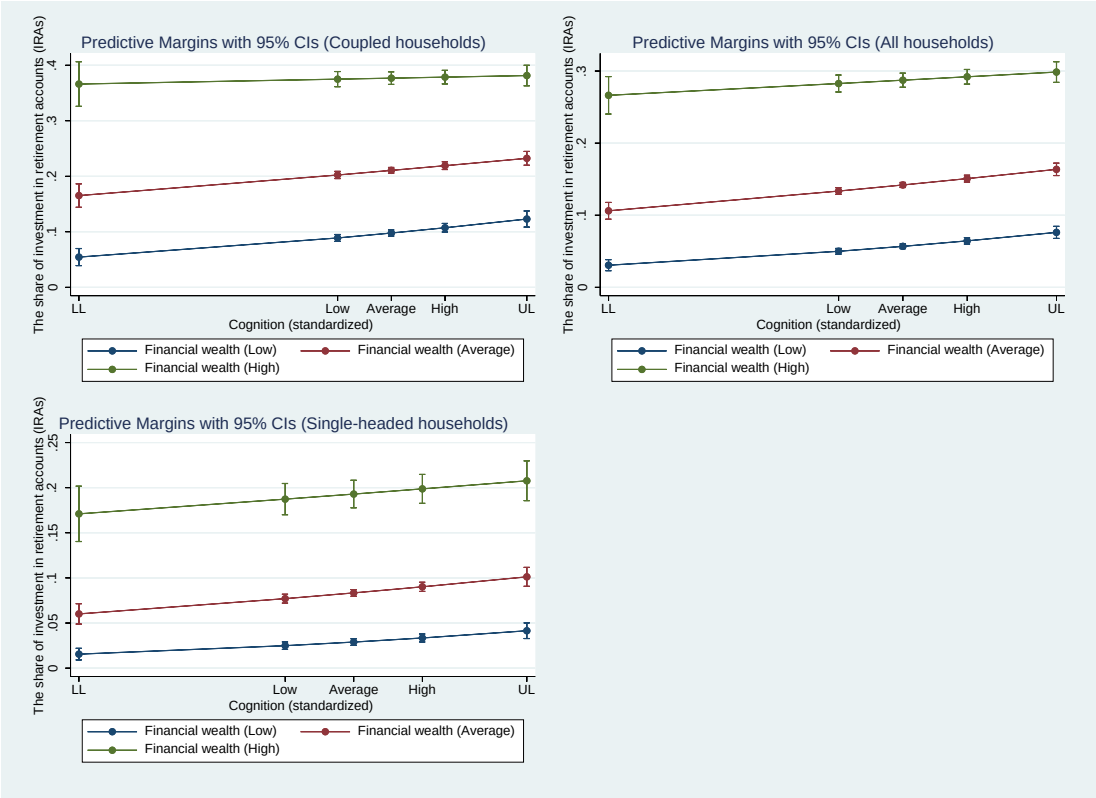
Table 2.6 reports the effect of cognition abilities on the fraction of total household investments allocated to ISA assets among UK households.

The fraction of total investments held in ISA accounts among UK households

Variables	All households (1)	All households (2)	Coupled households (1)	Coupled households (2)	Single-headed households (1)	Single-headed households (2)
Main effect						
Cognition (Tr20)	0.013***	0.012***	0.011***	0.010***	0.013***	0.013***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Control effect						
Age	-0.014***	-0.014***	-0.005	-0.006	-0.020***	-0.020***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)	(0.004)
Retired	0.012**	0.013**	0.008	0.009	0.012	0.004*
	(0.005)	(0.005)	(0.007)	(0.007)	(0.008)	(0.007)
Number of Children	-0.003**	-0.003**	-0.003	-0.003*	-0.003	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Physical	-0.002	-0.003	-0.006*	-0.006**	0.001	0.001
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Log (Household Income)	-0.009***	-0.008***	-0.010***	-0.009**	-0.008**	-0.007**
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Log (Financial wealth)	0.058***	0.056***	0.044***	0.043***	0.070***	0.070***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Log (Housing wealth)	0.007***	0.007***	0.007***	0.007***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log (debt)	-0.001	-0.001**	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
College	0.001	0.003	-0.003	-0.002	0.014*	0.014*
	(0.006)	(0.006)	(0.007)	(0.007)	(0.009)	(0.008)
Male	-0.051***	-0.053***			-0.050***	-0.051***
	(0.009)	(0.009)			(0.008)	(0.008)
Year2004	0.005	0.005	0.002	0.002	0.010	0.010
	(0.004)	(0.004)	(0.006)	(0.006)	(0.006)	(0.006)
Year2006	0.016***	0.016***	0.006	0.006	0.028***	0.028***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)
Year2008	0.037***	0.038***	0.023***	0.023***	0.055***	0.055***
	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)
Year2010	0.041***	0.041***	0.037***	0.038***	0.046***	0.045***
	(0.005)	(0.005)	(0.007)	(0.007)	(0.008)	(0.008)
Coupled household	0.059**	0.061***				
	(0.008)	(0.008)				
Interaction effect						
*Cognition*Log(Financial asset)*		-0.084***		-0.061***		-0.080***
		(0.007)		(0.008)		(0.011)
*Cognition*the coupled households*		-0.008				
		(0.015)				
Observations	26,517	26,517	14,857	14,857	11,660	11,660
Number of Households	8,738	8,738	4,942	4,942	3,982	3,982

Note: This table illustrates the estimation results of the GEE population-averaged model with time dummies. The average marginal effect is estimated with robust standard errors clustered at the household level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively. Other effects, including those of demographic factors, wealth, and physical health effect are controlled for. Column (1) reports the results without interaction items and Column (2) reports the results with interaction items.

Figure 2.9 illustrates the moderation effect of financial wealth on the relationship between cognitive score and the fraction of total investments held in retirement accounts (IRAs) in the US households. The *x*-axis represents cognitive abilities, and the *y*-axis represents the fraction of total investments held in IRA accounts. Lines of different colours represent different levels of financial wealth.



US households (all)

Moderator: Financial wealth	Average marginal effect	SD	Z	P>|Z|
Low (-1 SD from mean)	0.007***	0.001	5.39	0.000
Average (0 SD from mean)	0.009***	0.002	5.66	0.000
High (+1 SD from mean)	0.005*	0.003	1.81	0.071

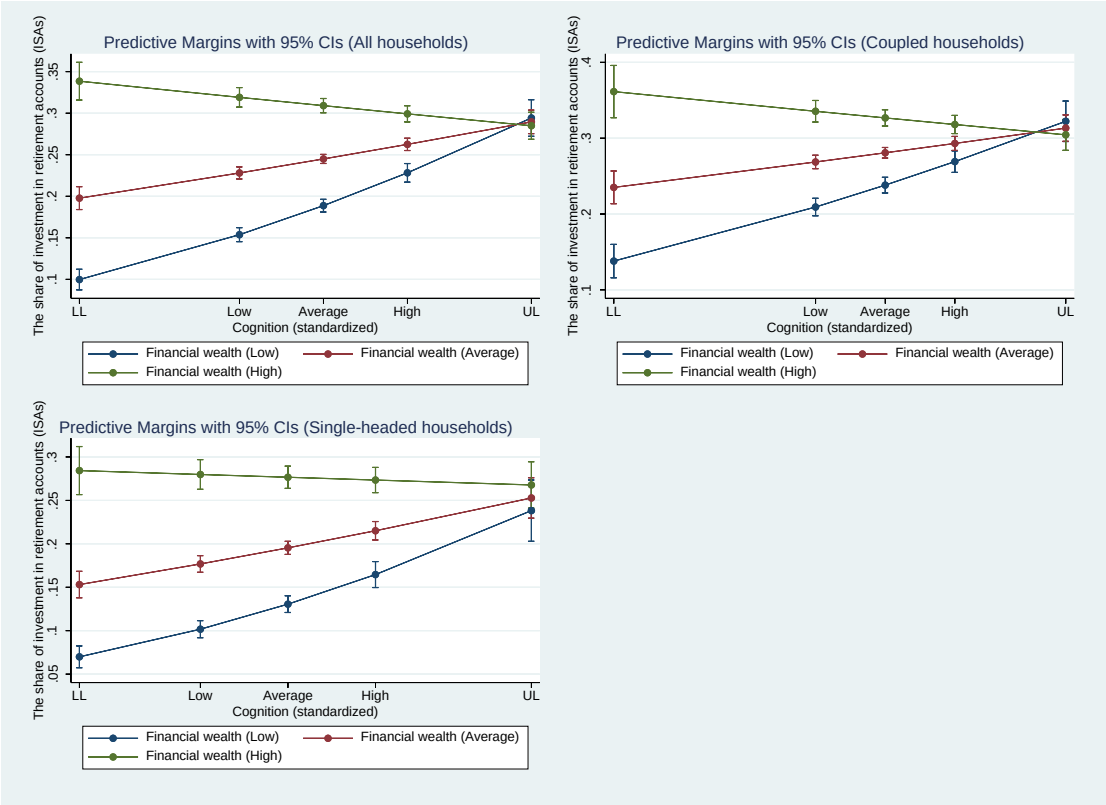
US households (coupled)

Moderator: Financial wealth	Average marginal effect	SD	Z	P>|Z|
Low (-1 SD from mean)	0.009***	0.002	4.28	0.000
Average (0 SD from mean)	0.008***	0.002	3.99	0.000
High (+1 SD from mean)	0.002	0.003	0.56	0.575

US households (single-headed)

Moderator: Financial wealth	Average marginal effect	SD	Z	P>|Z|
Low (-1 SD from mean)	0.004***	0.001	3.44	0.001
Average (0 SD from mean)	0.006***	0.002	3.75	0.000
High (+1 SD from mean)	0.006*	0.003	1.66	0.097

Figure 2.10 illustrates the moderation effect of financial wealth on the relationship between cognitive score and the fraction of total investments held in retirement accounts (ISAs) in UK households. The *x*-axis represents cognition abilities, and the *y*-axis represents the fraction of total investments held in ISAs. Lines of different colours represent different levels of financial wealth.



UK households (all)

Moderator: Financial wealth	Average marginal effect	SD	Z	P>|Z|
Low (-1 SD from mean)	0.037***	0.003	11.64	0.000
Average (0 SD from mean)	0.017***	0.002	6.90	0.000
High (+1 SD from mean)	-0.010***	0.003	-3.00	0.005

UK households (coupled)

Moderator: Financial wealth	Average marginal effect	SD	Z	P>|Z|
Low (-1 SD from mean)	0.029***	0.004	7.61	0.000
Average (0 SD from mean)	0.012***	0.003	4.15	0.000
High (+1 SD from mean)	-0.009**	0.004	-2.23	0.026

UK households (single-headed)

Moderator: Financial wealth	Average marginal effect	SD	Z	P>|Z|
Low (-1 SD from mean)	0.032***	0.004	7.69	0.000
Average (0 SD from mean)	0.019***	0.003	5.58	0.000
High (+1 SD from mean)	-0.003	0.005	-0.67	0.501

2.5.1.2 Cognitive abilities and the share of total investments held in retirement accounts

Table 2.5 and Table 2.6 examine the effect of cognitive skills on the share of the investments held in retirement accounts, respectively by US households (IRAs) and UK households (ISAs), respectively. These tables report the average marginal results of the GEE population-averaged model with time dummies. The results are estimated with robust standard errors clustered at the household level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, correspondingly. I control for demographic factors, wealth, and physical health, as well as economics trends (with year dummies). Column (1) reports results without interaction items and Column (2) reports results with interaction items.

According to Table 2.5, the first intuitive finding is that cognitive abilities are positively associated with the share of financial assets invested in IRA assets among US households. In other words, heads of households with higher cognitive abilities are more comfortable allocating a larger share of their portfolios to IRA assets, which supports *hypothesis b1*. These findings are supported by consistently significant estimators across different subgroups of the US sample. For every standard deviation unit increase in cognition score (standardized), the proportion of financial assets invested in IRA assets increases by around 0.006. The second finding is wealth negatively moderates the relationship between the cognitive abilities and the proportion of financial assets invested in IRAs. In other words, when households have more financial wealth, the positive effect of cognitive abilities on the share of financial assets invested in IRAs frequently became weaker, which supports *hypothesis b3*. I present Figure 2.9 to illustrate these results. In this figure, the *x*-axis represents cognition abilities and the *y*-axis represents the share of financial assets invested in IRAs. Lines of different colors represent different levels of wealth. It is remarkable that among UK households, the positive effect of cognitive abilities on the share allocated to IRA assets weakens as the level of financial wealth increases. Third, there is no evidence to support *hypothesis b2*, because the estimator of the interaction item between cognitive abilities and the gender composition of households is not significant.

Table 2.6 shows, first, that cognitive abilities are positively associated with the share of total financial assets invested in ISA assets among UK households. In other words, heads of UK households with higher cognitive abilities tend to allocate a larger share of their portfolios to ISA assets, which supports *hypothesis b1* and is similar to the results for the US sample. This finding is supported by the consistently significant estimators across different subgroups of the UK sample. For every standard deviation unit increase in cognition score (standardized), the proportion of financial assets invested in ISA accounts increases by approximately 0.012. Second, the value of financial assets negatively moderates the relationship between cognitive

abilities and the share of financial assets invested in the ISA assets. In other words, when households have greater levels of financial wealth, the positive effect of cognitive abilities on the share of financial assets invested in ISAs frequently weakens, which supports *hypothesis b3*. I present Figure 2.10 to illustrate these results. The *x*-axis represents cognition abilities, and the *y*-axis represents the share of financial assets invested in ISAs. Lines of different colors represents different levels of financial wealth. The data shows that the positive effect of cognitive abilities on the share of ISA assets weakens as the financial wealth of UK households increases. Third, there is no evidence to support *hypothesis b2*, because the estimator of interaction item between cognitive abilities and the gender composition of UK households is not significant.

The empirical results presented in this subsection support *hypotheses b1 and b3* in both the US and the UK. The results do not support *hypothesis b2*, for either the US sample or the UK sample.

2.5.1.3 Cognitive abilities and the share of investment in risky assets

Table 2.7 and Table 2.8 examine the effect of cognitive abilities on the proportion of total investments held in risky assets, for US households and UK households, respectively. These tables present the average marginal results of the GEE population-averaged model with time dummies. Results are estimated with robust standard errors clustered at the household level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. I control for demographic factors, wealth, and physical health, as well as for economic trends (with year dummies).

Table 2.7 shows that coefficients on cognition abilities are non-significant across the subgroups of US households, indicating that cognitive abilities do not significantly affect the share of financial assets invested in risky assets. Consequently, *hypothesis c1* is not supported in the US sample. Therefore, I infer that neither *hypothesis c2* nor *hypothesis c3* will hold for the US sample.

Table 2.8 shows that the coefficients of cognition abilities are marginally significant for only the coupled households at approximately 0.4% but are not significant for single-headed households or all households. Therefore, *hypothesis c1* is only true for some but not all UK subgroups. Since *hypothesis c1* is not true for any US subgroup and only partially true for the UK sample, I conclude that *hypothesis c1* is not supported by the empirical analysis and in turn *hypotheses c2* and *c3* are not supported.

Table 2.7 reports the effect of cognitive abilities on the fraction of total investments held in the risky assets among US households.

The fraction of investments held in risky assets among US households

Variables	All households	Coupled Households	Single-headed households
Main effect			
Cognition	0.002	0.003*	0.001
	(0.001)	(0.002)	(0.002)
Control effect			
Age	0.010***	0.010***	0.012***
	(0.002)	(0.003)	(0.002)
Retired	-0.012***	-0.014***	-0.008**
	(0.003)	(0.004)	(0.004)
Number of Children	-0.001	0.001	-0.001
	(0.001)	(0.001)	(0.001)
Physical	0.001	0.001	-0.001
	(0.001)	(0.002)	(0.002)
Log (Household Income)	0.009***	0.013***	0.004*
	(0.002)	(0.002)	(0.002)
Log (Financial wealth)	0.141***	0.134***	0.137***
	(0.002)	(0.003)	(0.003)
Log (Housing wealth)	0.001*	0.001	0.001**
	(0.001)	(0.001)	(0.001)
Log (debt)	0.002***	0.002***	0.002***
	(0.001)	(0.001)	(0.001)
College	0.035***	0.035***	0.043***
	(0.003)	(0.005)	(0.005)
Male	-0.009*		-0.007
	(0.005)		(0.005)
Year1998	0.004	0.004	0.005
	(0.003)	(0.004)	(0.004)
Year2000	0.001	-0.003	0.007
	(0.003)	(0.005)	(0.005)
Year2002	-0.008**	-0.013***	-0.002
	(0.003)	(0.005)	(0.005)
Year2004	-0.008**	-0.012***	-0.002
	(0.003)	(0.005)	(0.005)
Year2006	-0.017***	-0.030***	-0.004
	(0.004)	(0.005)	(0.005)
Year2008	-0.033***	-0.041***	-0.023***
	(0.004)	(0.005)	(0.005)
Year2010	-0.032***	-0.043***	-0.019***
	(0.004)	(0.006)	(0.005)
Coupled households	-0.012**		
	(0.005)		
Observations	58,083	29,943	28,140
Number of Households	17,393	10,045	10,013

Note: This table illustrates the estimation results for the GEE population-averaged model with time dummies. The average marginal effect is estimated with robust standard errors clustered at the household level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Other effects, including those of demographic factors, wealth, and physical health, are controlled for.

Table 2.8 reports the effect of cognitive abilities on the fraction of total investments held in risky assets among UK households.

The fraction of total investments held in risky assets among UK households

Variables	All households	Coupled households	Single-headed households
Main effect			
Cognition (Tr20)	0.002	0.004*	0.001
	(0.002)	(0.002)	(0.002)
Control effect			
Age	-0.008***	-0.004	-0.010***
	(0.002)	(0.004)	(0.003)
Retired	-0.006*	-0.011**	-0.001
	(0.003)	(0.005)	(0.005)
Number of Children	0.003**	0.003	0.003**
	(0.001)	(0.002)	(0.002)
Physical	-0.004***	-0.005**	-0.003
	(0.002)	(0.002)	(0.002)
Log (Household Income)	0.009***	0.014***	0.005*
	(0.002)	(0.004)	(0.003)
Log (Financial wealth)	0.078***	0.070***	0.081***
	(0.003)	(0.004)	(0.004)
Log (Housing wealth)	0.004***	0.004***	0.003***
	(0.001)	(0.001)	(0.001)
Log (debt)	0.004***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)
College	0.018***	0.018***	0.020***
	(0.004)	(0.005)	(0.005)
Male	0.003		-0.001
	(0.005)		(0.005)
Year2004	-0.009***	-0.010**	-0.008*
	(0.003)	(0.004)	(0.004)
Year2006	-0.014***	-0.012***	-0.017***
	(0.003)	(0.005)	(0.005)
Year2008	-0.028***	-0.030***	-0.026***
	(0.004)	(0.005)	(0.005)
Year2010	-0.024***	-0.029***	-0.018***
	(0.004)	(0.005)	(0.005)
Coupled households	-0.026***		
	(0.006)		
Observations	26,517	14,857	11,660
Number of Households	8,738	4,942	3,982

Note: This table illustrates the estimation results of GEE population-averaged model with time dummies. The average marginal effect is estimated with robust standard errors clustered at the household level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Other effects, including those of demographic factors, wealth, and physical health, are controlled for.

Table 2.9 reports the effect of cognitive abilities on the number of financial asset types held by US households

	The number of financial asset types held by US households		
Variables	All households	Coupled Households	Single-headed households
Main effect			
Cognition	0.064***	0.060**	0.073**
	(0.005)	(0.027)	(0.043)
Control effect			
Age	-0.194	-0.881*	-1.463***
	(0.136)	(0.466)	(0.514)
Retired	0.032	0.019	0.049
	(0.048)	(0.069)	(0.077)
Number of Children	0.082***	0.097**	0.039
	(0.030)	(0.044)	(0.063)
Physical	0.029	0.049	-0.014
	(0.025)	(0.038)	(0.050)
Log (Household Income)	0.146***	0.158***	0.129***
	(0.027)	(0.043)	(0.041)
Log (Financial wealth)	2.754***	2.648***	2.689***
	(0.051)	(0.068)	(0.033)
Log (Housing wealth)	0.040***	0.062**	0.026**
	(0.010)	(0.027)	(0.013)
Log (debt)	0.012**	0.004	0.025**
	(0.010)	(0.007)	(0.011)
College	0.019	1.413***	1.284*
	(0.134)	(0.540)	(0.677)
Male	-0.097		0.450
	(0.138)		(0.597)
Year1998	-0.291***	-0.243**	-0.028
	(0.058)	(0.117)	(0.144)
Year2000	-0.272***	-0.117	0.358
	(0.076)	(0.199)	(0.231)
Year2002	-0.497***	-0.157	0.335
	(0.010)	(0.292)	(0.336)
Year2004	-0.474***	0.012	0.583
	(0.123)	(0.379)	(0.431)
Year2006	-0.826***	-0.267	0.567
	(0.147)	(0.470)	(0.532)
Year2008	-0.906***	-0.176	0.710
	(0.172)	(0.563)	(0.633)
Year2010	-0.911***	-0.048***	1.012
	(0.203)	(0.671)	(0.617)
Coupled households	0.103		
	(0.104)		
Observations	41,418	22,098	14,473
Pseudo R2	0.247	0.232	0.252

Note: This table illustrates the estimation results of fixed-effect ordered logistic model with time dummies. Coefficients are estimated with robust standard errors clustered at the household level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Other effects, including those of demographic factors, wealth, and physical health, are controlled for. Pseudo R2 is reported.

Table 2.10 reports the effect of cognitive abilities on the number of financial asset types held by UK households.

	The number of financial asset types held by UK households		
Variables	All households	Coupled households	Single-headed households
Main effect			
Cognition (Tr20)	0.065**	0.030	0.096**
	(0.008)	(0.036)	(0.048)
Control effect			
Age	0.077	0.275	-0.017
	(0.450)	(0.767)	(0.567)
Retired	0.073	0.120	-0.012
	(0.071)	(0.094)	(0.108)
Number of Children	0.034	0.020	0.037
	(0.038)	(0.047)	(0.070)
Physical	0.018	-0.009	0.068
	(0.050)	(0.064)	(0.079)
Log (Household Income)	0.059*	0.060	0.050
	(0.034)	(0.051)	(0.048)
Log (Financial wealth)	1.824***	1.659***	1.886***
	(0.054)	(0.066)	(0.088)
Log (Housing wealth)	0.022	0.019	0.029
	(0.014)	(0.020)	(0.020)
Log (debt)	0.018**	0.020**	0.022
	(0.008)	(0.010)	(0.016)
Year2004	-0.124	-0.141	-0.167
	(0.117)	(0.191)	(0.155)
Year2006	-0.306	-0.351	-0.333
	(0.194)	(0.325)	(0.249)
Year2008	-0.402	-0.519	-0.377
	(0.284)	(0.483)	(0.360)
Year2010	-0.447	-0.636	-0.379
	(0.373)	(0.637)	(0.471)
Coupled households	0.526**		
	(0.252)		
Observations	21,974	13,025	8,610
Pseudo R2	0.170	0.165	0.173

Note: This table illustrates the estimation results of the fixed-effect ordered logistic model with time dummies. Coefficients are estimated with robust standard errors clustered at the household level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Other effects, including those of demographic factors, wealth, and physical health, are controlled for (*college* is excluded by the ordered logistic model with fixed effect because there is no time variation over the years). Pseudo R2 is reported.

2.5.2 Cognitive abilities and the number of financial asset types

In this subsection, I report the empirical results for the US and the UK sample regarding the relationship between cognitive abilities and the number of financial asset types. Table 2.9 and Table 2.10 report the coefficients from the fixed-effect ordered logistic model with time dummies for the US and the UK, respectively. The results are estimated with robust standard errors clustered at the household level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively. I control for those of demographic factors, wealth, and physical health, as well as for economics trends (with year dummies).

Table 2.9 shows that cognitive abilities are positively associated with the number of financial asset types held by US households. Across all subgroups, the coefficients are approximately 0.065 and all are statistically significant. Therefore, *hypothesis d* is supported for the US sample.

Table 2.10 shows that in the UK sample, the coefficients of cognitive abilities are significantly positive for all households and for single-headed households, but are not significant for coupled households. Consequently, *hypothesis d* is supported for all households and for the single-headed households in the UK sample.

In summary, the results demonstrate the overall positive effect of cognitive abilities on the diversification of household financial assets and thus *hypothesis d* is supported. In other words, cognitive abilities positively affect the diversification of household financial portfolios.

2.6 Discussion

In the previous section, I empirically examined the effect of cognitive abilities on the share of household financial portfolios invested in different types of financial assets and on the degree of portfolio diversification. In this section, I will first highlight the statistically significant findings. Second, I will compare the results of this paper with the results presented in previous related papers. Third, I will discuss the implications of this study and suggest directions for future research.

2.6.1 Summary of findings

The results of the present study support the following hypotheses:

Hypothesis a1: *Cognitive abilities are negatively associated with the share of financial assets invested in risk-free assets.*

Hypothesis a2: *Household composition moderates the effect of cognitive abilities on the share of financial assets invested in risk-free assets (However, this moderation effect goes in opposite direction for the US and UK samples).*

Hypothesis b1*: Cognitive abilities are positively associated with the share of financial assets invested in retirement accounts.*

Hypothesis b3*: The total value of the financial assets moderates the effect of cognitive abilities on the share of investment in retirement accounts.*

Hypothesis *d*: *Cognitive abilities positively affect the degree of diversification of financial assets held by households (i.e., the number of financial asset types).*

Regarding *hypothesis a1*, I find that heads of households with higher cognitive levels are more likely to reduce the share of financial assets invested in risk-free assets. This finding is not surprising. Christelis et al. (2010) suggest there are two channels through which cognitive abilities can influence the decision to purchase financial assets, one of which is the cost of collecting and processing information, which is lower for individuals with higher cognition. Therefore, it infers that skilled individuals tend to hold lower shares of riskless assets, as they are capable of obtaining benefits by allocating a larger proportion of their portfolio to non-risk-free assets at an acceptable cost.

Regarding *hypothesis a2*, I find that the size of the effect of cognitive abilities on the proportion of risk-free assets significantly differs between coupled households and single-headed households. This finding contributes to the literature on the impact of household composition on the relation between cognitive abilities and the share of financial portfolios held in safe assets. I tentatively put forward that gender composition plays a role in this result. Specifically, coupled households differ from single-headed households in this regard, which may be becase bargaining is conducted between partners who share decision-making power for financial behaviours whereas the heads of single-headed households make these decisions alone. (Lundberg et al., 2003; Kirchler et al., 2008; Bogan and Fertig, 2013). Interestingly, the moderation effect of household composition on the relationship between cognitive abilities and the share of total financial wealth held in risk-free assets is opposite in the US and the UK. In the US sample, coupled households tend to hold a reduced share of risk-free assets compared with single-headed households, whereas in the UK sample, single-headed households are more likely to hold a reduced proportion of risk-free assets compared with coupled households. I am unable to confirm or infer the possible reasons for this difference between the two samples, which is a drawback of this study. It is possible that men and women in the US and the UK prefer different portfolio strategies.

Regarding *hypothesis b1*, the findings indicate that cognitive abilities are positively associated with the share of investments held in retirement accounts, which are less risky than risky assets but riskier than the risk-free assets. According to the channels through which cognitive abilities can influence the decision to purchase financial assets, as proposed by Christelis et al. (2010), this finding is a complement to the proven *hypothesis a1*. Specifically, these hypotheses present a systematic picture that highlights the increased fraction of financial assets in retirement

accounts and the decreased fraction of total investment in safe assets, due to positive moderation effect of cognitive abilities over years. I give two possible explanations. First, regarding the cost of collecting and processing information, skilled individuals tend to reduce the share of their investment in safe assets and correspondingly increase the percentage of investment in retirement account, in order to obtain greater financial benefits, because of tolerating the higher level of risk for retirement accounts. Second, regarding preference heterogeneity, especially relating to risk aversion, individuals with higher cognitive abilities prefer to allocate a larger share of financial assets to retirement accounts and a smaller share to risk-free assets because these people are less risk aversion (Dohmen et al., 2010). Another possible explanation is that households with higher cognitive abilities are more likely to have access to expensive resources from which they can obtain relevant information that helps them to earn higher returns and reduces absolute risk aversion. The potential rewards of riskier assets provide ample reason for households with higher cognitive level to invest a larger proportion of their wealth in such assets (Peress, 2004). I note that the results for one subgroup do not show a positive relationship between cognitive abilities and the share of investments allocated to risky assets, i.e., UK coupled households, although the signs of the corresponding estimates are uniformly positive, as shown in Table 2.7 and Table 2.8. According to the taxonomy of Hurd (2002), the risk ranks of financial assets in descending order are as follow: risky assets (high risk), bond and retirement account (medium risk), and risk-free assets (safe assets). Thus, I suspect that heads of households with high cognition scores endeavor to strike a balance between risk and benefits, and make a middle-of-the-road choice to hold a larger percentage of their financial assets in retirement account, rather than in risky assets. To summarize, this finding indicates that the positive link between cognition and risky investment behaviour exists but is not always linear; rather, it may be conditional on other determinants, such as gray matter loss due to age (Roalf et al., 2011), ambiguity aversion (Dimmock et al., 2016), or culture (Hofstede, 2003). I believe this relationship warrants further examination and clarification.

Regarding *hypothesis b3*, the level of financial wealth moderates the effect of cognitive abilities on the share of investments held in retirement accounts. Specifically, the effect of cognitive abilities on the share of financial assets held in retirement accounts increases uniformly for households with average and low levels of financial wealth. This result indicates that people near or in retirement aim to maintain good financial situations by preserving a significant amount of financial wealth, which can earn capital income. If they maintain a good status of cognition, in terms of calculation, analysis, and memory, they can ably process information regarding portfolio diversification, which avoid not only the high risk of direct stock trading but also the likelihood of earning limited interest-based income from safe assets. For households with high level of financial wealth, consumption can continue for longer periods

and the desire to increase wealth levels may be weaker compared with other groups, assuming that their cognitive abilities remain at good levels. In other words, the intention of cognitively skilled households keep wealth accumulation by holding larger shares of their investments in retirement accounts weakens as wealth level increases.

Regarding *hypothesis d,* cognitive abilities are positively associated with the degree of diversification of household financial portfolio (i.e., the number of financial asset types held by households). In other words, cognitively skilled families are more likely to diversify their investments, by investing in different types of financial assets. There are several benefits to the diversification of financial assets. First, it diminishes long-term risk (Elton and Gruber, 1977; Jagannathan and Ma, 2003). Second, portfolio diversification guarantees returns that are higher than the worst performing investment in the long-run if investors adopt a buy-and-hold strategy. In other words, diversification narrows the range of possible outcomes. Third, a diversified portfolio has a higher percentage of low-risk, income and value investments. I provide new evidence of the positive association between cognitive abilities and the degree of household portfolio diversification, although this evidence is slightly weaker than other main findings because a positive association is not found for UK coupled households. According to Figure 2.2, the reason for this discrepancy may be that the average number of financial asset types held by UK coupled households is rather close to three (out of a possible four), indicating that they are already highly diversified, and earning relatively stable capital income.

In addition to main findings, I reveal a difference in the effect of cognitive abilities on the share of investment in risky assets between the US and the UK. Specifically, results reveal that cognitive ability is not significantly associated with the share of investment allocated to risky assets for the entire US sample, US coupled sample, or US single-headed sample, which is consistent with the results of Christelis et al. (2010) based on an EU biennial-based panel survey. However, a positive association between cognitive abilities and the share of investment in risky assets is marginally significant ($p<0.1$) for the UK coupled sample, and not significant for the UK single-headed sample or UK entire sample. I try to explain this discrepancy from the perspective of preference heterogeneity, including ambiguity aversion and risk aversion, which are both determinants of the fraction of investments held in risky assets. The majority of the estimates of the relationship between cognition and the fraction of investment allocated to risky assets have no significance, which I attribute to the positive link between age and risk averse (Morin and Suarez, 1983; Halek and Eisenhauer, 2001). The decline of gray matter in aging and elderly populations over time (Grubb et al., 2016) suggests a decreased risk tolerance.

However, risk aversion cannot fully explain the significant association between cognitive abilities and the fraction of financial assets held in risky assets among UK coupled households

when no such association exists UK single-headed household or among US households. Thus, ambiguity aversion may also have an impact. First, a previous study reports that ambiguity aversion is not associated with age (Grubb et al., 2016). Second, British people are more comfortable with uncertainty (i.e., ambiguity), compared with American people (Hofstede, 2003). In other words, British people are less averse to ambiguity than Americans are. In addition, ambiguity aversion is negatively associated with both stock market participation and the fraction of household investments allocated to equity assets (Dimmock et al., 2016). Since people within a particular group (i.e., coupled households) are more likely to make ambiguity neutral decisions after discussion and individuals show inconsistent tolerance of uncertainty (i.e., exhibiting ambiguity aversion, ambiguity seeking, and ambiguity neutrality) (Keck et al., 2014), it may be that British coupled households decide to increase the percentage of their retirement savings allocated to risky assets when their cognition levels are good.

2.6.2 Theoretical implications

First, the present study extends the theory regarding the relationship between cognitive capacity and financial decision-making. An existing strand of literature mainly examines the relationship between cognitive abilities (or related concepts) and stock market participation. For example, Christelis et al. (2010) consider the relationship between cognitive abilities and portfolio choices, and find that there is a strong positive association between cognitive capacity and stock market participation. Similarly, Grinblatt et al. (2011) study the relationship IQ and stock market participation and, confirm the finding of Christelis et al. (2010). They further approve that the effect of cognitive abilities on the stock market participation exists among wealthy people and females. In the same vein, Van Rooij et al. (2011) test the relationship between financial literacy (which is also a cognitive concept) and stock market participation. They report that individuals with low financial literacy are much less likely to invest in the estock market. These papers open the door to a discussion about the effects of cognitive on stock market participation, but do not examine the effect of cognitive abilities on household portfolio choices. Thus, this paper contributes to the literature by documenting that cognitive abilities are negatively associated with the share of investment in safe assets, and positively associated with the proportion of financial assets allocated to retirement accounts. Another strand of literature primarily researches the relationship between cognition-related variables and portfolio diversification. For example, Guiso and Jappelli (2008) find that measures of financial literacy are strongly associated with the degree of portfolio diversification. Jappelli and Padula (2013) propose an intertemporal portfolio choice model that implies a positive association between financial literacy accumulated from lifetime stock market participation and portfolio diversification. In addition, von Gaudecker (2015) reports that portfolio under-diversification

ranks among the costliest household investment mistakes, which are completely contrary to optimization. Their results suggest that increased financial literacy can reduce wealth losses that stem from inferior loss. Therefore, this paper contributes to the literature by documenting the positive influence of cognitive abilities on the degree of household portfolio diversfiication.

Second, this paper overcomes the problem of unobserved heteroscedasticity by using panel data (Hsiao, 2007) and selects the measures of cognitive abilities that do not suffer endogeneity problems because they are unlikely to be affected by the ownership of particular financial assets. Notably, the samples and measures of cognitive abilities used in this paper differ from those used in related articles. For example, Christelis et al. (2010) study cross-sectional data from the Survey of Health, Ageing and Retirement in Europe (SHARE) and use mathematical, verbal fluency, and recall skills to measure different aspects of cognitive abilities. Grinblatt et al. (2011) use Finnish panel data and employ IQ as the measure of cognitive abilities. Van Rooij et al. (2011) consider cross-sectional data from the De Nederlandsche Bank (DNB) Household Survey and measure cognitive abilities based on financial literacy, which they believe is a more appropriate measure in the financial field, compared with general cognitive abilities. This paper uses the biennial panel survey data, HRS and ELSA, which represent the US and UK populations, respectively. The measure of cognition is a summer score proposed by Ofstedal et al. (2005) for US households and a sum score derived from word recalls for UK households.

Third, I try to interpret the possible channels through which cognitive abilities may influence portfolio choices. One channel might be the risk and time preferences. Donkers et al. (2001) report that individuals with higher educational levels could tolerate a higher level of risk in a hypothetical game. Christelis et al. (2010), Grinblatt et al. (2011), and Van Rooij et al. (2011) show that cognition-related variables (cognitive abilities, IQ, and financial literacy) are strong predictors of stock market participation. This stream of literature implies that higher cognitive abilities are associated with a lower degree of risk averse regarding financial decisions, such as the decision to participate in the stock market. Similarly, Benjamin et al. (2013) find experimental evidence that higher cognitive abilities are associated with a greater degree of patience and a lower level of risk aversion. In addition, Dohmen et al. (2010) find that individuals with lower cognitive abilities are more likely to make choices that are less future-oriented and less risky. According to the empirical results, this channel could be one through which cognitive abilities extent an influence on portfolio choices. Specifically, I find a positive (negative) correlation between cognitive abilities and the share of financial assets in retirement accounts (safe assets), which supports the notion that cognitive abilities are associated with risk aversion. The results do not show a positive association between cognitive abilities and the share of investment in risky assets for US households but do suggest such a positive association among UK coupled households, who increase the fraction of financial wealth held in risky

assets as their cognitive abilities increases. I argue that although a positive relationship between cognition and risk aversion is supported in the literature (Dohmen et al., 2010) and married households have a higher propensity to invest in risky assets (Bertocchi et al., 2011), this evidence only partially explains the mechanism at work here. In other words, risk aversion is likely one of several channels. The second channel may be overconfidence (Barber and Odean, 2001; Christelis et al., 2010). Yates (1990) reports that overconfidence varies substantially among individuals. Overconfidence tends to reveal itself when people confront difficult tasks, such as financial decision-making. Sims (2003) reports that individuals with low levels of cognitive abilities are more likely to underestimate financial risk. However, in this study, as cognitive abilities increases, the investment share of risk-free assets decreases while the share of investment in retirement accounts (which have a higher risk) increases. Hence, the results contradict the expectation based on this channel, showing that this channel is less likely to exist. The third possible channel is the cost of human capital (Christelis et al., 2010). Investing in different financial assets requires an investment of human capital, in terms of the time and effort required to be familiar with terminologies about different financial terminology and to process financial information. This cost tends to be a barrier that prevents individuals with low cognitive levels from accessing complex markets. For example, Campbell (2006) reveals that certain households opt not to invest in the stock market because there is an information barrier, which will entails costs. Korniotis and Kumar (2005) show that those with lower cognitive abilities face a higher cost for stock market participation. If this cost is not paid, a low-skilled person may make financial mistakes (Agarwal and Mazumder, 2013). According to the results, the positive (negative) association between cognitive abilities and the fraction of total financial assets in retirement accounts (risk-free assets) supports the idea that human capital cost is a channel that explains the mechanism behind the findings. Furthermore, cognitive abilities positively influence the degree of diversification of financial assets, which further supports the argument that the cost of human capital is a valid channel.

2.6.3 Practical implications

The data indicate that households in both countries adopt a two-fold strategy: 1) decline the fraction of total financial assets allocated to safe asset and risky asset; 2) increase the percentage of investment in retirement accounts, such as IRAs and ISAs. In other words, households shift their portfolio from the two extreme tiers to the middle tier, which is not only less risky than trading stock directly but also earns higher returns compared with safe assets. In addition, in the section 2.3.5 (Descriptive statistics), I note that UK aging households` average financial wealth did not decline over the sample period, even during the great recession (2008-2010), whereas US households suffered losses as time passed, especially during the volatile financial

period. A remarkable difference in portfolio structure between US and UK households is that UK households have a larger share of their investment in retirement accounts compared to US households (approximately 12%), on average. I infer that this difference may have contributed to the maintenance of financial wealth among UK households and the decline of financial wealth among US household during the same period. In the literature, cognition positively predict wealth accumulation (Banks and Oldfield, 2007; McArdle et al., 2009) and tax-deferred accounts (such as IRAs) promote increased wealth accumulation (Gomes et al., 2005). The findings reveal that both US and UK households apply a shifting strategy whereby they reduce the shares of investment in safe and risky assets, and increase the fraction of investment in retirement account. Therefore, I speculate that increased cognition levels could be one possible channel to maintain, or even to increase financial wealth of people who are near retirement or have retired. This implication yield practical insights that may help to protect financial well-being of older cohorts by preventing or protecting against aging-related cognition decline. In particular, individuals can engage in physical activity (Lautenschlager and Almeida, 2006), keep social connections (Cacioppo and Hawkley, 2009), implement mindfulness meditation (Zeidan et al., 2010), maintain good sleep quality (Scullin and Bliwise, 2015), and reduce chronic stress (Marin et al., 2011). On the other side, financial institution should not only continue to provide tax-free investor accounts (e.g., ISAs) and tax-deferred investor accounts (e.g., IRAs) but also strive to increase financial literacy or financial matter-related cognition (Banks and Oldfield, 2007; Gerardi et al., 2010). In Particular, financial institutions may help to decrease consumer bias and motivate consumers to save more if consumers' assets are under their management (Barr et al., 2009). In addition, firms could educate consumers on financial terminologies to correct their misperceptions (Stango and Zinman, 2009). Regarding policy maker, they should consider the implementation of regulations that decrease the costs of decision-making for investors in financial intermediary markets (Thaler and Sunstein, 2008). Policy makers could also enact default rules (Beshears et al., 2008) and provide public support for financial education.

2.6.4 Limitations and recommendations for future research

Although I highlight the theoretical contributions of this paper and provide insight regarding possible channels through which cognitive abilities influence household portfolio choices, this study has several limitations. First, the sample groups represented in the panel data from the US and UK national surveys mainly comprise aging populations. Therefore, the external validity of the findings is restricted to aging groups. Second, although I propose one possible channel through which cognitive abilities might affect household portfolio choices, this proposition is based on deduction, rather than direct empirical evidence. Therefore, I cannot

conclude that the proposed channel is necessarily accurate. Third, due to a lack of the completeness of the cognitive measures in the UK panel, the measures of cognitive abilities used for the US and the UK samples are not identical, which may lead to biased results. Finally, only one type of measure is used to assess cognitive abilities in this paper.

However, future research can address the limitations described above, in the following ways. First, the external validity of these findings could be tested by empirically examining the effect of cognitive abilities on the share of financial portfolios allocated to particular assets and on the degree of portfolio diversification in different age groups, such as middle-aged and younger groups. Second, future research could conduct customized local surveys to collect abundant samples. Such surveys could include items related to risk aversion, time preference, and overconfidence and apply a mediation anlaysis to determine whether these factors are the channels through which cognitive abilities influence the shares allocated to different financial assets and the degree of portfolio diversification. In addition, future research can use different sub-measures of cognitive abilities, such as numeracy, fluid intelligence, number series, or cognitive speed, to conduct a robustness check on the findings. Finally, a descriptive analysis and explanatory examination do not establish causality in the association between cognitive abilities and allocations to different financial assets. I cannot deny a possibility that individual acquire good numerical skills after investing in markets that require high levels of cognition (e.g., stocks and mutual funds). Nevertheless, I use a summary measure of cognition from the HRS that encompasses multiple dimensions of cognition. Because this measure captures general information about multiple dimension of cognition, I believe it excludes the possibility of a reverse relationship. To measure cognition using the ELSA data, I used episodic memory (or word recall); this particular cognitive dimension can be enhanced by pharmacological treatment (Apud et al., 2007; Dunbar et al., 2007) rather than life experience. Therefore, future research may conduct discriminating tests to assess whether the relationships examined in the present paper reflect the true relationships.

2.7 Conclusion

After the economic recession, there is an unambiguous desire among policy-makers and financial institutions to understand and promote the quality of household financial decisions (Agarwal and Bhashkar, 2013). This paper examines the effect of cognition on changes in US and UK household wealth and on the composition of that wealth. The sample pool is taken from two national longitudinal surveys, the HRS in the US and ELSA in the UK. These surveys provide ample portfolio and demographic information, including a broad range of covariates, which reduces problems of omission and establishes a comprehensive basis for analysis. In

addition, both datasets are panel data, which control for unobserved heteroscedasticity and enhance the accuracy of inferences of model parameters (Hsiao, 2007).

Old cohorts in both the US and the UK frequently shifted their financial portfolios away from equity assets and safe assets, and toward retirement account. I also detect that the wealth of UK households slightly increased during the 2002-2010 period despite experiencing a financially volatile period (2008-2010). In contrast, US households on average experienced declines over the 1998-2010 period, especially during the financially volatile period (2008-2010).

I also examined whether cognition is a predictor of changes in portfolio choices; the results generally support this expectation. First, the results show that a negative correlation between cognitive abilities and the share of financial assets in risk-free assets. Second, the results indicate that individuals with higher cognitive levels prefer to allocate a larger percentage of financial assets in retirement accounts, such as IRAs in the US and ISAs in the UK. Third, these relationships are uniformly significant for households with low and median levels of financial wealth. In other words, financial wealth moderates the relationship between cognition and the percentage of financial assets invested in retirement accounts. Moreover, heads of households with higher cognitive abilities are more likely to diversify their financial portfolios. I cannot empirically confirm the channel through which cognitive abilities can influence household financial portfolios. However, I discuss three possible alternatives, including risk and time preference, overconfidence, and human capital investment, as proposed by Christelis et al. (2010). I deduce that the cost of human capital stemming from information barriers is the likeliest channel. Another interesting finding of this study is that cognitive abilities do not affect the share of financial assets allocated to risky assets, which is consistent with the conclusion of Christelis et al. (2010); however, education attainment is a significant predictor of variance in the proportion of risky assets in a financial portfolio. This paper complements the theory regarding the correlation between cognitive abilities and household portfolio choices by showing a systematic picture wherein cognitive abilities contribute to changes in aging cohorts` asset allocations and diversification in the US and the UK, which may also contribute to preservation of financial wealth and financial well-being among the elderly. Finally, I provide practical implications for consumers, firms, and the government to protect against age-related cognitive decline, and to promote enhanced financial literacy.

Chapter 3 Does perfectionism affect individual financial risk tolerance, wealth accumulation, and gambling behaviour?

Abstract

This study investigates the effects of perfectionism on tolerance for financial risk and wealth accumulation and explores the possible channels through which these effects occur. Perfectionism encompasses two essential facets: striving and evaluative concerns. Financial risk tolerance is a subjective function of the financial risk that an investor can accept. I implement a cross-sectional study with an online survey sample of 661 US residents. First, perfectionistic striving is positively associated with financial risk tolerance, but perfectionistic concerns have no impact on financial risk tolerance. Second, the positive link between perfectionistic striving and financial risk tolerance is consistent in different demographic subgroups based on gender, age, religion, and marital status. Third, perfectionistic striving (concerns) positively (negatively) predicts liquid wealth mediated by investment knowledge. Furthermore, investment knowledge itself, and investment knowledge followed by liquid wealth are two channels through which perfectionistic striving and concerns affect financial risk tolerance. Finally, perfectionistic concerns inhibit gambling expenditures. This study extends the understanding of the influence of perfectionism on individual financial well-being.

3.1 Introduction

Traditionally, perfectionism has been thought to cause many psychopathologies (Frost et al., 1990). For example, Pacht (1984) proposes that perfectionism is a widespread and crippling problem that is associated with many psychological and physical disorders. In the most recent clinical psychology literature, perfectionism has also been associated with the etiology and continuation of eating and anxiety disorders, as well as with depression (Shafran and Mansell, 2001). However, Hamachek (1978) argues that there are two distinct types of perfectionists and two dimensions of perfectionism: normal and neurotic. Hamachek (1978) proposes that normal perfectionists seek to achieve adaptively based on their high standards, whereas neurotic perfectionists are overly concerned about mistakes and overly worried about failure, leading to adverse outcomes. Hence, this view indicates that there are both active and passive dimensions of perfectionism. Frost et al. (1990) and Hewitt and Flett (1991) suggest that perfectionism has multiple dimensions. Stoeber and Otto (2006) further generalize that striving for high standards and worrying about mistakes are the two core aspects of active and negative perfectionism, respectively.

Empirically, individuals characterised by perfectionistic striving exhibit higher academic, musical, and athletic performance (Stoeber et al., 2008) with positive affect and endurance (Bieling et al., 2003). Hence, perfectionistic striving spurs individuals to fight for what they want, to set higher standards than others`, and to exert their best efforts to achieve their goals (Murphy, 2012). By contrast, individuals characterised by evaluative concerns are associated with negative emotions, low self-esteem and low self-efficacy (Dunkley et al., 2003), leading to goal orientation avoidance and self-defeatism (Stoeber and Becker, 2008; Stoeber et al., 2008; Sagar and Stoeber, 2009).

Although the effects of perfectionism on multiple domains of life (academic study, music, athletics, work, etc.) have been widely studied, whether and how perfectionism influences individual decision-making on investments or personal well-being in the financial field have not been systematically investigated. In particular, little is known about whether and how perfectionism influences individual risk tolerance and wealth accumulation. Financial risk tolerance is the extent of financial risk a person is willing to accept (Van de Venter et al., 2012); financial risk tolerance is important because it can predict a broad range of essential economic outcomes (Guiso and Paiella, 2006; Eckel et al., 2005). At the same time, wealth drives individual well-being (Headey and Wooden, 2004). Therefore, it is valuable to explore the potential effects of perfectionism on financial risk tolerance and wealth accumulation.

Recent studies have examined gambling as a form of risk taking, especially when there is a high chance of losing and a lower chance of winning (Mishra et al., 2010). Personality traits and risk taking have both been associated with gambling involvement. By participating in gambling, people expose their money to an anticipated adverse outcome and to uncertainty (Mishra et al., 2010). Brand and Altstötter-Gleich (2008) emphasize that perfectionism can affect decision-making in risky situations when the rewards and punishments are stipulated (e.g., gambling), while other personality traits only mildly predict the variance in decisions under ambiguous conditions when there are multiple possible outcomes. The results of these studies are derived from neuropsychological decision-making tasks, which do not reflect daily life. The actual outcomes resulting from the correlation between perfectionism and gambling behaviour remain unclear.

The present paper aims to examine whether perfectionism predicts financial risk tolerance, wealth, and gambling behaviours. I conduct a cross-sectional analysis using OLS regression and quantile regression to investigate the relationships between the variables of interest mentioned above. I use an online survey and collect information from 661 respondents randomly selected from the US general population. I obtain four general findings. First, financial risk tolerance increases with the extent of perfectionistic striving, whereas evaluative concerns are not directly associated with financial risk tolerance. Second, striving (evaluative concerns) is associated with increased (decreased) investment knowledge, which is in turn associated with increased (decreased) liquid wealth. Third, the magnitude of the indirect effect of perfectionistic striving on liquid wealth is greater than the magnitude of the effect of evaluative concerns on liquid wealth. Subsequently, I report two channels through which perfectionistic striving influences financial risk tolerance. The first channel is investment knowledge, and the second channel is investment knowledge followed by liquid wealth. A direct effect of striving on risk tolerance exists, and its magnitude is larger than the magnitude of the indirect effects. Furthermore, perfectionistic concerns are negatively associated with financial risk tolerance only through these indirect channels: investment knowledge and investment knowledge followed by liquid wealth. The results do not show any direct relationship between evaluative concerns and risk tolerance. Finally, perfectionistic concerns inhibit gambling expenditures. The findings remain the same after a robustness check.

These findings have important implications for theoretical and empirical research on behavioural finance and for policy design intended to improve financial well-being and life satisfaction. First, theoretically, the results enhance the evidence that perfectionism has both active and negative facets that can generate positive and adverse outcomes, such as increased and decreased liquid wealth and greater and reduced risk tolerance, respectively. Second, empirically, wealth always represents a form of control when simultaneously investigating the

associations between perfectionism and other fundamental variables in different life domains. With respect to policy implications, these findings support the development of deliberate interventions to support individuals with poor financial well-being, poor life satisfaction, and worse negative effects. Such interventions might include professional financial courses, adaptive perfectionism-oriented psychological counseling and education to not only promote investment knowledge but also foster internalized standards for achievement and reduce excessive concerns about making mistakes and being evaluated by others.

The remainder of this paper proceeds as follows. Section 3.2 reviews the relevant literature to provide a foundation for hypothesis development. Section 3.3 describes the methods of sampling and data measurement. Section 3.4 presents the methodology. The results are reported in Section 3.5 and discussed in Section 3.6. I conclude the paper in Section 3.7.

3.2 Literature Review

First, this section successively introduces definitions, relevant research and conventional measures of perfectionism, investment knowledge, and financial risk tolerance. Second, I establish the specific research questions and corresponding hypotheses for this study. Few studies have drawn attention to the interrelationships among the factors considered here. This research gap thus provides an opportunity to obtain more sophisticated and comprehensive knowledge regarding the effects of perfectionism on financial outcomes, in terms of investment knowledge, wealth accumulation, and financial risk tolerance.

3.2.1 Perfectionism

Perfectionism is commonly understood as a set of personality traits characterized by striving for flawlessness and setting high standards for performance; it can also include tendencies toward striving to exceed applicable criteria (Frost et al., 1990; Hewitt and Flett, 1991; Stoeber and Otto, 2006).

Traditionally, perfectionism has been linked with psychopathology and psychodynamic theory, which emphasizes that perfectionism is closely correlated with a neurotic and disordered personality (Missildine, 1963). Hamachek (1978) distinguished between two dimensions of perfectionism - normal perfectionism and neurotic perfectionism - and was the first to propose the positive form of perfectionism. Studies in the 1980s support the notion that perfectionism is associated with high levels of depression, eating disorders, and obsessive-compulsive disorder in both clinical and non-clinical populations (Rosen et al., 1989; Hewitt et al., 1989). At the beginning of the 1990s, Frost et al. (1990) and Hewitt and Flett (1991) verified that

perfectionism encompasses multiple dimensions, and they propose a multi-scale measurement for perfectionism. Refining all facets of the definition of perfectionism, Frost et al. (1993) suggest two core dimensions of perfectionism – *positive strivings* and *negative evaluation concerns*. These authors show that evaluative concerns are associated with negative characteristics, whereas the strivings dimension is associated with positive characteristics, providing the first empirical evidence that there is a positive dimension of perfectionism. Reports following Frost et al. (1993) also present evidence regarding the association between positive strivings and positive life outcomes. For example, perfectionistic striving is positively associated with positive affect, effort, academic achievement, and performance, as well as with self-efficacy (Stumpf and Parker, 2000; Stoeber and Kersting, 2007; Stoeber et al., 2008).

Stoeber and Otto (2006) systematically review papers that report empirical evidence of positive strivings and negative evaluation concerns, and they conclude that perfectionistic striving exists. They also propose a conceptual framework combining striving and evaluative concerns as well as groups of perfectionists (healthy perfectionists, non-healthy perfectionists, and non-perfectionists), as shown in Figure 3. They challenge the widely accepted conception that perfectionism is only destructive. Because perfectionism is prevalent in society, a deeper understanding of its effects on individual well-being in multiple domains is required (Antony et al., 1998; Sassaroli et al., 2008).

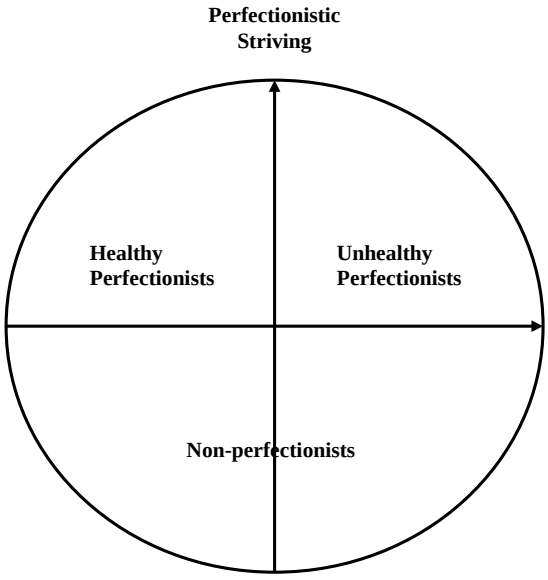


Figure 3. Two basic aspects of perfectionism, as original distinguished by from Stoeber and Otto (2006).

Measurement tools for multi-dimensional perfectionism vary. The two main measures are the Frost Multidimensional Perfectionism Scale (F-MPS) proposed by Frost et al. (1990) and the Hewitt Multidimensional Perfectionism Scale (H-MPS) introduced by Hewitt and Flett (1991). The former consists of a 35-item scale with six subscales (concerns regarding mistakes, personal standards, parental expectations, parental criticism, doubts regarding actions and organization), whereas the latter consists of 45 items measuring three dimensions (self-oriented

perfectionism, socially prescribed perfectionism, and other-oriented perfectionism). Because subsequent papers have empirically shown that active striving and negative evaluation concerns are the most common central dimensions of perfectionism, Burgess et al. (2016) recently proposed a short version of the F-MPS, called the F-MPS-Brief, which effectively captures these two dimensions. Therefore, in the present study, I use F-MPS-Brief to measure perfectionism.

3.2.2 Investment knowledge

In personal finance, investment knowledge is a cognitive skill that is similar to a language. There is no system of direct instruction to help people develop investment knowledge (Forbes and Kara, 2010). In fact, the majority of individuals are not sufficiently competent in the field of investment knowledge (Benish, 1998).

Chen and Volpe (1998) investigate the effect of financial knowledge on investment opinions and decisions. They created a personal finance questionnaire and distributed it to students at 14 different universities. Their results indicate that students have low levels of financial knowledge, and the authors show that personal financial knowledge significantly influences opinions and decisions about investing. The literature also reveals the effect of financial knowledge on economic outcomes. First, investment knowledge is positively associated with stock ownership (Van Rooij et al., 2011; Christelis et al., 2010). Those with high financial knowledge are more likely to engage in retirement planning, resulting in wealth accumulation (Lusardi and Mitchell, 2007; Lusardi and Mitchell, 2008). Second, low levels of financial literacy lead to expensive mortgages. Stango and Zinman (2009) find that those who cannot calculate interest rates correctly tend to borrow more money and accumulate less wealth. Third, self-reported and objective financial knowledge have been shown to influence credit card behaviour throughout life (Allgood and Walstad, 2013). Financial knowledge is more specialized than general knowledge (education) and contributes to financial decision-making (Lusardi and Mitchell, 2014).

There are three types of valid and reliable measures of financial knowledge. The first one comprises three independent questions and was proposed by Lusardi and Mitchell (2011). They built this measure using four principles, i.e., simplicity, relevance, brevity, and capacity to differentiate. Further, they argue that this measure effectively captures three concepts: 1) numeracy and interest rate calculations; 2) comprehension of inflation; and 3) understanding of risk diversification (Lusardi and Mitchell, 2014). The sum score of the three questions yields an individual's financial literacy. The second measure is a 13-item scale proposed by Fernandes et al. (2014). These authors refine their measure with 26 items used in previous studies in a

meta-analysis, and they report that this measure has high psychometric properties. A respondent's answers to these questions determine his or her financial literacy. The third measure consists of one self-reported question, proposed by Cooper et al. (2014). I use the third measure, which is concise and straightforward.

3.2.3 Financial risk tolerance

Van de Venter et al. (2012) define financial risk tolerance as the amount of financial risk an individual is willing to accept. Traditionally, economists have considered financial risk tolerance as an objective function of real personal financial behaviours, including the risk of the assets held by a person. Hanna and Chen (1997) argue that financial risk tolerance might be a personality trait derived from a genetic predisposition. Cesarini et al. (2010) confirm this argument by providing evidence that nearly 20% of the observed variance in an individual's willingness to tolerate financial risk might be due to genetic differences. Van de Venter et al. (2012) further consolidate this view by presenting financial risk tolerance as a time-invariant personality trait that is unlikely to change extensively throughout an individual's life.

There are three main approaches to measuring personal financial risk tolerance. The first approach is a multidimensional risk measure (the GL-RTS), a 13-item index that involves the constructs of investment risk, risk comfort and experience, and speculative risk (Grable and Lytton, 1999). Gable and Lytton (2003) approve this measure`s validity by comparing a summated score of its 13-item scale with asset allocation choice. The second approach is a single-item measure from the Survey of Consumer Finances (SCF); this measure is used in many surveys. Gilliam et al. (2010) report that both the GL-RTS and the single-item measure from the SCF are valid, but the GL-RTS has a higher explanatory power than the single-item measure from the SCF. The third approach is a 25-item measure developed by an Australian company, FinaMetrica Pty Limited, and the Applied Psychology Unit of the University of New South Wales School of Psychology. Van de Venter et al. (2012) use this measure to support their findings. After balancing the explanatory power and the number of items, I choose to use the GL-RTS because long and complicated questions might lead to comprehension problems and mental fatigue among respondents (Sarstedt et al., 2009).

3.2.4 Hypothesis development

Based on the theoretical groundwork discussed above, I establish hypotheses to explore the interrelationship among perfectionism, investment knowledge, liquid wealth, financial risk tolerance, and gambling expenditure.

3.2.4.1 Perfectionism and financial risk tolerance (H1)

I hypothesize that perfectionism influences financial risk tolerance. On the one hand, perfectionistic striving is positively correlated with positive psychological features, processes, and outcomes, such as endurance, positive affect, athletic performance, musical performance, educational performance, expectations, and hopes regarding success (Stoeber et al., 2008; Bieling et al., 2003; Murphy, 2012). Second, perfectionistic striving is positively linked with self-efficacy and aspiration level (Stoeber et al., 2008). Self-efficacy is a personal resource that involves the positive self-belief in an individual's capabilities to exercise control over a variety of challenging tasks and to address negative events (Schwarzer and Jerusalem, 1995). Consequently, self-efficacy is positively associated with risk-taking (Krueger and Dickson, 1994). Therefore, I hypothesize the following:

H1a: Perfectionistic striving is positively associated with financial risk tolerance.

By contrast, perfectionistic concerns are typically associated with negative emotions, low self-esteem, low self-efficacy, and fear of failure (Dunkley et al., 2003; Stoeber and Otto, 2006). Second, perfectionistic concerns are negatively associated with self-efficacy and aspiration level (Stoeber et al., 2008). In addition, Brand and Altstötter-Gleich (2008) argue that individuals with severe perfectionistic concerns may tend to make non-risky choices to avoid mistakes. Hence, I anticipate the following:

H1b: Perfectionistic concerns are negatively associated with financial risk tolerance.

Perfectionism is a personality trait that typically compels individuals to strive for higher standards and leads to critical self-evaluations; perfectionism is sustainable and relatively stable (Rice and Aldea, 2006). Financial risk tolerance is also a stable trait that is less likely to change as time passes (Van de Venter and Michayluk, 2008). Thus, these relationships should also be relatively stable. Figure 3.1 depicts the conceptual model for Hypothesis H1a and Hypothesis H1b.

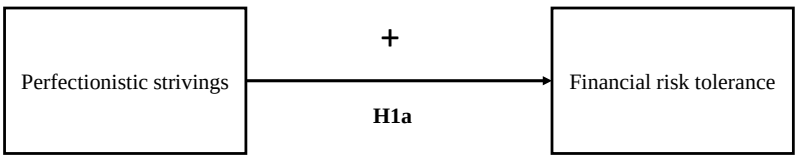


Figure 3.1a describes the conceptual model for Hypothesis 1a. The direction of the arrow shows the hypothesized effect

Figure 3.1b describes the conceptual model for Hypothesis 1b. The direction of the arrow shows the hypothesized effect

3.2.4.2 The mediating role of investment knowledge (H2)

I hypothesize that investment knowledge mediates the relationship between perfectionism and the accumulation of liquid wealth. The rationale behind this hypothesis is that personality is generally associated with knowledge, and knowledge predicts performance (Crook et al., 2011). In the present paper, perfectionism is one type of personality trait (Stoeber and Childs, 2010), and investment knowledge is specific knowledge in the finance domain that affects an individual's capability to plan and implement a regular investment program (Van Rooij et al., 2011). Wealth accumulation is the performance that directly influences financial well-being. What is the justification for creating a sensible link between perfectionism and investment knowledge? First, perfectionism is an extreme form of conscientiousness (Koivula et al., 2002) and therefore is associated with conscientiousness (Stoeber et al., 2009b). In other words, perfectionism is internally motivated (Stoeber and Stoeber, 2009). Second, acquiring new knowledge entails dutiful deference to self-interests and personal goals, such as acquiring capital income by investment and subsequently achieving financial freedom, or maintaining good financial well-being. More specifically, perfectionistic striving is positively associated with self-efficacy and aspiration level (Stoeber et al., 2008), whereas self-efficacy is positively related to mental effort and achievement (Schunk, 1991). Self-efficacy is also positively associated with learning (Martocchio and Judge, 1997). Common sense suggests that learning is positively associated with knowledge acquisition. Hence, I anticipate that perfectionistic striving is positively associated with investment knowledge. Moreover, financial knowledge is positively associated with wealth accumulation (Van Rooij et al., 2012). Therefore, I propose the following hypothesis:

H2a: Investment knowledge mediates the relationship between perfectionistic striving and liquid wealth

On the other hand, perfectionistic concerns are negatively associated with self-efficacy and aspiration level (Stoeber et al., 2008), whereas self-efficacy is positively associated with mental effort and achievement (Schunk, 1991). At the same time, self-efficacy is positively associated with learning (Martocchio and Judge, 1997). Common sense suggests that learning is positively

associated with knowledge acquisition. Therefore, I anticipate that perfectionistic concerns are negatively associated with investment knowledge. Moreover, financial knowledge is positively associated with wealth accumulation (Van Rooij et al., 2012). Therefore, I derive the following hypothesis:

H2b: Investment knowledge mediates the relationship between perfectionistic concerns and liquid wealth

Figure 3.2 depicts the conceptual model for Hypothesis H2a and Hypothesis H2b.

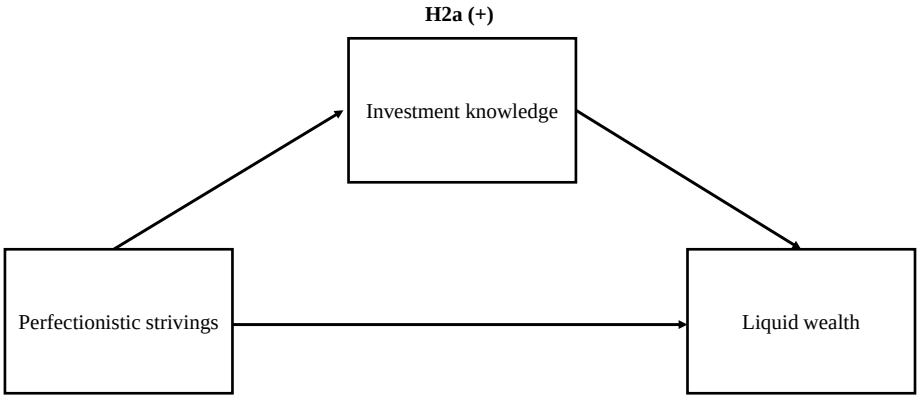


Figure 3.2a describes the conceptual models for Hypothesis 2a. The directions of the arrows show the hypothesized effects.

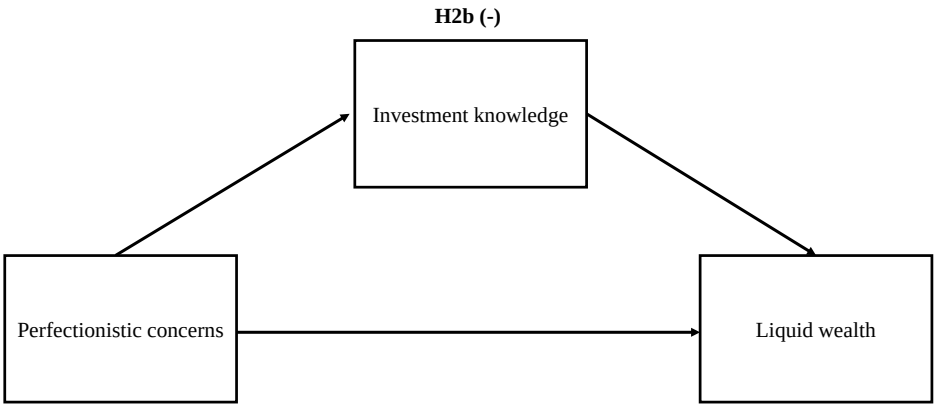


Figure 3.2b describes the conceptual models for Hypothesis 2b. The directions of the arrows show the hypothesized effect.

3.2.4.3 The serial mediating role of investment knowledge and wealth accumulation (H3)

I hypothesize that investment knowledge and liquid wealth serially mediate the relationship between perfectionism and financial risk tolerance. Guiso and Paiella (2008) document that risk tolerance is a concave function of wealth when accounting for the endogeneity of the endowment and unobserved intellectual capabilities. In addition, Dohmen et al. (2011) report

that wealthier individuals are more willing to take risks. Based on this discussion, I hypothesize the following:

H3a: Investment knowledge and liquid wealth serially mediate the relationship between perfectionistic striving and financial risk tolerance.

H3b: Investment knowledge and liquid wealth serially mediate the relationship between perfectionistic concerns and financial risk tolerance.

Figure 3.3 depicts the conceptual model for Hypothesis H3a and Hypothesis H3b.

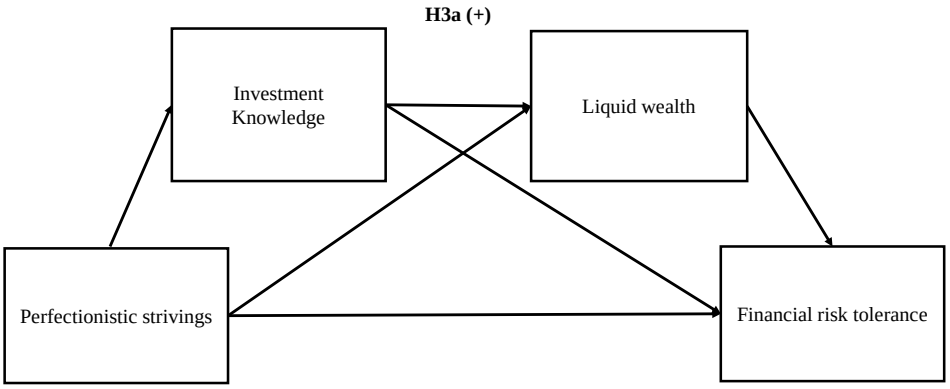


Figure 3.3a describes the conceptual model for Hypothesis 3a. Investment knowledge and the liquid wealth serially mediate the relationship between perfectionistic strivings and financial risk tolerance. The directions of the arrows show the hypothesized effect.

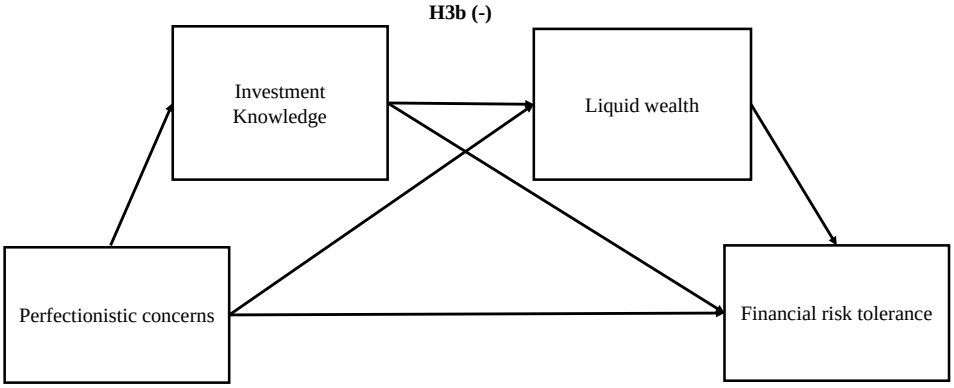


Figure 3.3b describes the conceptual model for Hypothesis 3b. Investment knowledge and the liquid wealth serially mediate the relationship between perfectionistic concerns and financial risk tolerance. The directions of the arrows show the hypothesized effect.

3.2.4.4 Perfectionism and monthly gambling expenditures (H4)

Decision-making under risk appears to be differentially linked to distinct facets of perfectionism (Brand and Altstötter-Gleich, 2008). I hypothesize that individuals with high personal standards (high striving) may tend to spend more money on gambling if they have been participating in gambling because they can bear the financial risk in order to obtain more money from gambling. I also hypothesize that individuals with intensive concerns about mistakes or doubts about outcomes (high evaluative concerns) are more likely to spend less

money on gambling if they have been participating in gambling because they may prefer to optimize the consequences of their financial decisions and to dodge mistakes and condequently avoid negative feedback (Brand and Altstötter-Gleich, 2008). Based on this discussion, I hypothesize the following:

H4a: Evaluative concerns are negatively associated with monthly gambling expenditures.

H4b: Striving is positively associated with monthly gambling expenditures.

3.3 Data Description

In this section, I introduce the sampling method, data validity, and data description. I conducted a quantitative study because the current measures of perfectionism, financial risk tolerance, investment knowledge, and wealth are all quantitative. In addition, based on my research questions, I aim to investigate the potential relationships among the above-mentioned factors in the general population, and I conducted a cross-sectional study in this preliminary investigation (Bryman and Bell, 2015). I used the survey data for statistical analysis in order to identify relationships (Lowry and Gaskin, 2014).

3.3.1 Sampling

I used a web survey and sent email invitations to potential respondents. The email contained basic information about the research content, a link to the online survey, and the incentives for the respondents. In particular, I purchased a sampling service from an online panel vendor, Qualtrics, whose panel team supports survey construction by providing an assistant to develop complicated electronic questionnaires, distribute the survey to an established panel group and record the results. The collected data can be downloaded as a CSV format file (Barnhoorn et al., 2015) for statistical analysis. Ethics and Research Governance of author`s institution approved this study.

I designed one questionnaire that included demographic information (12 questions), and questions about perfectionism (8 questions), investment knowledge (5 questions), financial risk tolerance (11 questions) and financial behaviours (5 items). I launched the survey twice. In the first launch, I collected data from a population (group A) ranging in age between 18 and 54 years. In the second launch, I collected data from a population (group B) older than 55 years. For group A, I distributed 524 questionnaires and received 365 completed surveys. Therefore, the response rate for group A was 69.6%. The remaining 159 were marked as non-responses, primarily for four reasons: not eligible (82), screened out by attention filters (37), unwilling to participate (38) and excessive time duration (2). Subsequently, I further excluded 64 answers

because 41 respondents did not provide information regarding their race, religion, assets, income, or investment years and 20 respondents provided unrelated answers to questions regarding loans, gambling expenditures, assets, income, expected retirement age, monthly expenses, or investment years. Therefore, there were 301 valid questionnaires for group A. Although I set 'force response' (i.e., respondents must answer all questions) for the entire survey, there are still missing values as shown above because some respondents refused to provide information in the open questions. I compensated respondents financially after the survey. For group B, I distributed 461 questionnaires and received 378 completed responses. Hence, the response rate for group B was 82.0%. There were 83 questionnaires marked as non-responses, generally because of unwillingness to participate (71) and attention (12). Moreover, I excluded an additional 18 responses. In particular, 10 of them answered, "I do not know", "N/A", "many", "no idea" or "sorry" in open questions regarding income, assets, loans, monthly expenses or investment years and 8 respondents provided unrelated or unreasonable answers to questions regarding country of residence, expected retirement or actually retirement age, monthly expenses, investment years, or income. Hence, I had 360 valid questionnaires for group B. Although I set 'force response' for entire survey, there are still missing values as shown above because some respondents did not provide information in the open questions. I provided the respondents with a financial incentive to complete the questionnaire. In total, I obtained data from 661 individuals who were US citizens and could access the Internet across different age subpopulations. The final response rate was consequently 75.4%.

3.3.2 Data validity

In general, collecting data by a web survey has both advantages and disadvantages (Bryman and Bell, 2015). The following discussion highlights the benefits and provides details on how the drawbacks of online surveys can be overcome.

Regarding advantages, the cost in time and money of data collection with a web survey is lower than that for collecting data with paper-and-pencil surveys (Couper, 2000; Llieva et al., 2002). In particular, Qualtrics utilizes multiple sample sources to meet customer needs. As a panel accumulator, they guarantee that all group subjects undergo regular monitoring and quality control checks. After working in a wide range of industries for many years, Qualtrics has established and maintained stable relationships with the largest and most well-known panel providers in the world (ESMOR 28 from Qualtrics, 2014). Second, web survey responses are much faster than traditional face-to-face or postal surveys, which helps researchers save time (Bachmann and Elfrink, 1996; Taylor, 2000; Yun and Trumbo, 2000). In this case, the panel teams of Qualtrics distributed my survey to reliable and targeted groups in the panel with an email invitation. Furthermore, Qualtrics provides multiple digital platforms for participants to

access web surveys without geographic or time restrictions. Finally, web surveys typically have fewer unanswered questions than traditional paper-and-pencil surveys (de Rada and Dominquez, 2013). Papers using Qualtrics online panels have been published in well regarded journals, such as Fernandes et al. (2014), Walters et al. (2016), and Hardisty and Pfeffer (2016) in *Management Science*, as well as Kuhnen and Miu (2017) in *Journal of Financial Economics.*

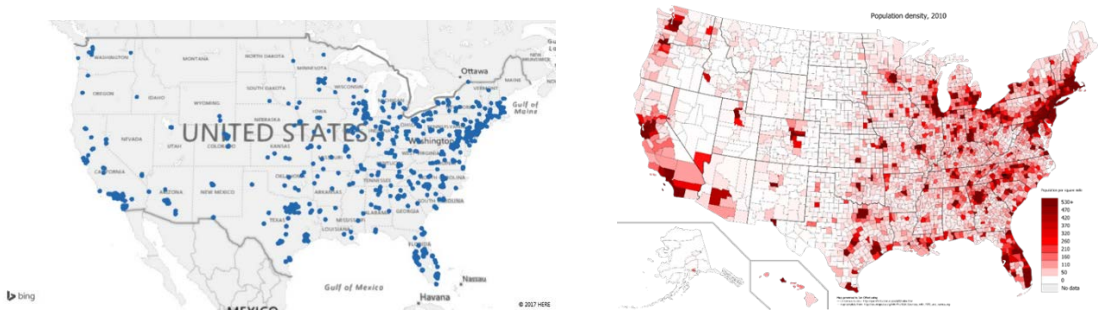
However, there are certain risks associated with the disadvantages of web surveys and the solutions that are used to overcome them. First, there can be problems with the response rate (Thompson et al., 2003). In my case, I addressed this issue by offering the respondents financial incentives. As mentioned above, the final response rate was 75.4%, which was higher than the minimum criterion (60%) (JAMA, 2013) and within the target interval (70% to 85%) recommended by Babbie (2004) and Singleton and Straits (2010). The second problem pertains to coverage. Ideally, when Internet penetration is 100%, web surveys will fully cover the general population. In reality, Internet penetration in the US is now 87.9% (Internet World Status, 2017), which is close to full coverage, indicating limited under-coverage bias. The third potential problem is self-selection bias, which is the main restriction of web survey research (Stanton, 1998). To diminish self-selection bias, Qualtrics sends potential respondents one email invitation containing the Internet link to the survey and basic information, such as the research purpose of the survey, how much time the survey will take and the incentives being offered. No specific survey question is disclosed in that email invitation. In addition, Qualtrics proportionally selects the sample from the general population and randomizes that sample before sending the survey link (ESMOR 28 from Qualtrics, 2014). The next drawback concerns fraudulent respondent. The Qualtrics panel team confirms respondent identity using TrueSample, Verity, SmartSample, USPS verification, and digital fingerprinting (ESMOR 28 from Qualtrics, 2014). Furthermore, the panel team authenticates the addresses, demographic details, and email addresses of respondents, and ensures that every valid response has a unique IP address.

In addition to overcoming particular obstacles regarding the web survey, there are other concerns about data quality, such as the sample's representativeness and validity. To achieve sample representativeness, simple random sampling is applied, which reduces sampling bias (Gravetter and Forzano, 2011). In my case, the Qualtrics panel team selected highly qualified respondents based on simple random sampling. Each respondent from the panel is representative of a portion of general population and is randomized before the survey is deployed. Therefore, I can reasonably assume that the sample in my survey is representative. To achieve data validity, Qualtrics prevents duplication by checking every IP address and applying an advanced digital fingerprinting technology. Furthermore, each strategic panel partner employs deduplication techniques to offer the most reliable data and to maintain the

integrity of the survey data. Finally, I added an additional screen-out setting involving attention filters and a time threshold.

I collected the data based on simple random sampling, which is an unbiased random selection approach (Scheaffer et al., 2011). This approach is vital to ensuring that when a large number of samples are drawn, the mean of the sample represents the general population. Nevertheless, this does not mean that one specific sample is a perfect representation of the general population. Simple random sampling allows us to generalize and make externally valid conclusion regarding the general population based on the sample. The data are from a geographically dispersed population, which is an advantage of a web-based survey. Consequently, I visualized the distribution of participants on a flat map of the US prepared in Excel 2016, showing the population density of the US in 2010 as sourced from the US Census Bureau (Figure 3.4), with the purpose of detecting any potential notable geographical bias. Each blue solid point represents the location of one participant. From the perspective of geography, the respondents are located across the states of the US; they are clustered heavily on the east coast, modestly on the south-west coast, and mildly in the middle part of the US. Figure 3.4 shows that US Census data and my sample have similar features with regard to population density. Therefore, I believe that my survey data are sufficiently representative of the general population of the US and are of good quality for further empirical analysis.

Figure 3.4 depicts the locations of the respondents from the US in my sample (left) and the population density of the US in 2010 as sourced from the US Census Bureau (right).



Note: Each blue solid point represents the location of one participant. From the perspective of geography, my sample is distributed randomly across the states of the US. The right diagram displays the population density of the US in 2010 Map source: http://backstory.us/; its data source is the US Census Bureau http://quickfacts.censuss.gov/qfd/index.html.

3.3.3 Data measurement and description

I include perfectionism measures, financial risk tolerance, investment knowledge, and demographic variables in the statistical model. I introduce measurements of variables and their corresponding abbreviations. Table 3.1 shows the summary statistics of all variables.

First, I use the mean indicator from the eight-item perfectionism scale (F-MPS-Brief) proposed by Burgess et al. (2016) to measure the two facets of perfectionism, i.e., perfectionistic striving, and perfectionistic concerns. Each item is a 5-scale Likert-type indicator, ranging from 1=strongly disagree to 5=strongly agree. This short version of the F-MPS provides one concise tool for measuring perfectionism and has been shown to be valid and reliable in terms of internal consistency, measurement equivalence across ethnicities and concurrency, in addition to convergence (Burgess et al., 2016). The details of these measurements are fully provided in Appendix B. In particular, I denote PS1, PS2, PS3 and PS4 as items to construct striving, and I define PEC1, PEC2, PEC3 and PEC4 to construct evaluation concerns. The higher the score of each PS (PEC) is, the more likely that the respondent is an adaptive (maladaptive) perfectionist.

I use an average indicator to measure striving and evaluative concerns. I tested the reliability of this measure with Cronbach's alpha (Cronbach, 1951). Hinton et al. (2014) proposed four interval-based categories to assess reliability of summative scale (Likert, 1932): excellent reliability (0.90 and above), high reliability (0.70-0.90), moderate reliability (0.50-0.70), and low reliability (0.50 and below). In particular, I calculate the arithmetic mean value of PS1, PS2, PS3, and PS4 to construct *Striving (average)*. Its Cronbach`s alpha=0.829, indicating it is highly reliable (Hinton et al., 2014). Similarly, I calculate the arithmetic mean value of PEC1, PEC2, PEC3, and PEC4 to construct Evaluative *concerns (average).* Its Cronbach`s alpha=0.641, which is moderately reliable (Hinton et al., 2014).

Second, financial risk tolerance is a latent terminology that indicates the extent of financial risk that an individual can tolerate in making financial decisions (Grable and Lytton, 1999). I employ a 13-item instrument (see details in Appendix B) to construct a sum-index, in which a higher score indicates a greater level of risk tolerance, as proposed by Grable and Lytton (1999). I use this index to measure financial risk tolerance (*FRT*), which ranges from 13 to 47.

Third, investment knowledge is the knowledge possessed by individuals who are equipped to make investment decisions, manage their own portfolio, and track the financial markets. I use a self-reported five-scale variable, proposed by Cooper et al. (2014), to measure investment knowledge. A higher score indicates a higher level of investment knowledge. Consequently, I define this variable as *Investment knowledge*.

I subsequently perform log transformations of liquid assets (e.g., money in savings and checking accounts, stocks, and bonds) and fixed assets (e.g., real estate, vehicles, collections, furniture, equipment) because log-transformation can help to normalize continuous data. These variables are non-negative and continuous and are defined as *Log_Liq_asset* and *Log_Fixed_asset* in the subsequent analysis.

Table 3.1 presents the summary statistics of the sample.

		The whole sample (1)				The gambling group (2)			
Variables		Mean	SD	Min	Max	Mean	SD	Min	Max
Main variables									
Perfectionism	PS1	3.527	1.076	1	5	3.604	0.995	1	5
(Striving)	PS2	3.313	1.152	1	5	3.511	1.023	1	5
	PS3	3.288	1.013	1	5	3.337	0.964	1	5
	PS4	3.641	0.986	1	5	3.760	0.889	1	5
Perfectionism	PEC1	2.121	1.188	1	5	2.275	1.226	1	5
(Evaluative concern)	PEC2	1.904	1.016	1	5	1.937	1.006	1	5
	PEC3	2.180	1.112	1	5	2.137	1.087	1	5
	PEC4	2.998	1.383	1	5	3.022	1.170	1	5
Striving (Average)		3.443	0.861	1	5	3.553	0.745	1	5
Evaluative concern (Average)		2.306	0.778	1	5	2.343	0.779	1	4.75
FRT		24.588	5.111	14	39	26.24	4.948	15	39
FL		8.726	2.481	2	13	8.666	2.591	4	13
Log_monthly_gambling		1.344	2.109	0	10.13	3.949	1.665	0.690	10.13
Gambling		0.340	474	0	1				
Control variables									
Age		5.372	1.364	0.5	8.8	5.267	1.381	0.5	8.1
Log_Annual_hincome		10.685	1.109	0	18.42	10.780	1.218	0	13.53
Education		3.845	1.402	1	7	3.911	1.333	2	7
Male		0.334	0.472	0	1	0.426	0.495	0	1
Marital_status		0.644	0.479	0	1	0.724	0.448	0	1
No_dep		1.099	1.358	0	10	1.386	1.537	0	10
Religion		0.717	0.451	0	1	0.733	0.443	0	1
White_race		0.873	0.333	0	1	0.866	0.341	0	1
Log_liq_asset		8.572	4.390	0	20.72	9.229	3.800	0	18.42
Log_fixed_asset		9.789	4.278	0	19.34	10.338	3.805	0	19.34
Employment		0.641	0.479	0	1	0.657	0.469	0	1
Investment knowledge		2.370	1.120	1	5	2.600	1.110	1	5
Investment year		4.534	6.681	0	35	5.804	7.247	0	35
Log_Loan		6.740	4.962	0	14.08	7.546	4.564	0	12.69
Number of observation	661					225			

Note: The data source is a web survey launched by Qualtrics, an online platform, in August 2016. This table reports the number of observations, means, standard errors, and minimums and maximums of the variables. I measure striving with an average indicator *Striving (Average)* from four 5-scale items. I measure evaluative concern with an average indicator *Evaluative concern (Average)* from 5-scale items. Financial risk tolerance is denoted by *FRT*. Financial literacy is denoted by *FL*. The logarithm of liquid assets is denoted by *Log_Liq_asset*, and the logarithm of fixed assets is denoted by *Log_Fixed_asset*. *Investment knowledge* is the knowledge possessed by individuals who are equipped to make investment decisions, manage their own portfolio, and track the financial markets. The control variables include Age/10 (*Age*), Annual household income (*Annual_hincome*), Educational attainment (*Education*), more than 55 years old (*Old*), gender (*Male*), whether married or living with a partner (*Marital status*), whether the individual is Caucasian (*White_race*), the number of dependent children (*No_dep*), and whether respondent has religious beliefs (*Religion*). *Log_Monthly_gambling* denotes the logarithm of monthly expenditures on gambling. *Gambling* is binary, denoting whether or not the respondent participates in gambling.

Following Grable (2000), I take gender, age, marital status, income, education and financial knowledge, as well as economic expectations, as control variables. In particular, *Age* measures the quotient of the age of an individual divided by 10. *Education* measures the highest educational attainment of a person, ranging from 1 (less than high school) to 7 (doctorate). *Male* is a dichotomous variable coded 1 for male and 0 otherwise. *Marital_status* is a binary variable coded 1 for living with a partner and 0 otherwise. *Religion* is a binary variable coded 1 for an individual who believes he or she belongs to a religion and 0 otherwise. *White_race* is a dichotomous variable coded one if an individual is Caucasian and 0 otherwise. *No_dep* defines

the number of dependent children in the respondent's household, which is non-negative and discrete. *Annual_hincome* is the logarithmic form of the annual income of a household before taxes. *Employment* is a binary variable that takes the value of one if an individual has a job or is self-employed, otherwise 0. *Log_loan* is the log-transformation of any loan that the respondent has. The original survey questions for these variables are documented in Appendix B.

3.4 Methodology

3.4.1 Econometric model for testing the link between perfectionism and risk tolerance (H1)

The first objective of this paper is to investigate the effect of perfectionism on financial risk tolerance. I use OLS regression and quantile regression, as the benchmark techniques. In particular, the OLS technique verifies the relationship between one or more independent variables and the conditional mean of the dependent variable. Quantile regressions, as proposed by Koenker and Bassett (1978), can characterize the entire conditional distribution of a dependent variable given a number of regressors. The quantile regression`s objective function is a weighted sum of absolute deviations, which provides a robust measure of location; thus, the estimated coefficient vector is not sensitive to outlier observations of the dependent variable. When the error term is non-normal, quantile regression estimators may be more efficient than least squares estimation. Quantile regression is one way to discover more predictive relationships between variables in situations where there is no relationship or only a weak relationship between the means of these variables. I use 10th, 25th, 50th, 75th, and 90th quantile regressions and examine the significance of the estimators by applying bootstrapped standard errors based on 1000 replications.

The OLS model is specified as follows:

$$FRT_i = Striving_i\beta + Evaluative_i\varphi + X_i\gamma + \alpha_i \quad (1)$$

FRT_i is the level of individual i`s financial risk tolerance. $Striving_i$ denotes the level of the positive aspect of perfectionism of individual i. $Evaluative_i$ represents the level of the negative aspect of perfectionism of individual i. X_i is a vector of control variables, including gender, age, employment status, educational attainment, race, religion, annual income of the household, number of dependent children, marital status, liquid wealth, and self-reported investment knowledge. α_i is the error term. Note that it is important to assess both perfectionistic striving and perfectionistic concerns simultaneously when researchers

investigate empirical correlation between perfectionism and other variables of interest because perfectionistic concerns can overpower the relationship between perfectionistic striving and the positive life outcomes (Hill et al., 2010).

I fit the following quantile model:

$$FRT_i(\tau) = Striving_i\beta(\tau) + Evaluative_i\varphi(\tau) + X_i\gamma(\tau) + \alpha_i(\tau) \quad (2)$$

$FRT_i(\tau)$ is the τth conditional quantile of the degree of individual i`s financial risk tolerance. $\beta(\tau)$ ($\varphi(\tau)$) is the corresponding coefficient of the level of positive (negative) aspect of perfectionism of individual *i* at the τth conditional quantile. $\gamma(\tau)$ is a vector of coefficients of control variables at the τ th conditional quantile. Furthermore, $\alpha_i(\tau)$ indicates the τ th conditional quantile of the error terms.

I apply both OLS and quantile regressions successively to examine whether there is a significant relationship between perfectionism and financial risk tolerance in the whole sample. I then test whether the relationship between perfectionism and financial risk tolerance is stable across different demographic subgroups according to gender, age>55 years, and employment status. I can also check whether there is any obvious discrepancy between genders (Jianakoplos and Bernasek, 1998), between older and younger groups (Albert and Duffy, 2012; Kurnianingsih et al., 2015), and between employed and unemployed groups (Diaz-Serrano and O'Neill, 2004) because of differences in risk aversion.

3.4.2 Investment knowledge as a mediator between perfectionism and liquid wealth (H2)

The second objective of this paper is to examine whether investment knowledge mediates the relationship between perfectionism and liquid wealth. Based on Baron and Kenny (1986), I particularly focus on OLS regressions as shown in Table 3.2. The direct and indirect effects of perfectionism are obtained from the results of two linear models. To test **H2a**, the relationship between striving, liquid wealth, and investment knowledge is estimated from perfectionism,

$$Invest\_know_i = a_{21}Striving_i + Evaluative_i\varphi + X_i\gamma + \alpha_i \quad (3)$$

Subsequently, liquid wealth is estimated from both striving and investment knowledge:

$$Liq\_assest_i = c'_{21}Striving_i + b_{21}Invest\_know_i + Evaluative_i\varphi' + X_i\gamma' + \alpha_i' \quad (4)$$

The direct effect of perfectionistic striving on liquid wealth is estimated with c'_{21} in equation (4). This parameter measures how much two cases that differ in striving by one unit are estimated to differ in liquid wealth independent of the effect of investment knowledge on liquid wealth. The *indirect effect* of striving on liquid wealth through investment knowledge is

estimated by $a_{21} \times b_{21}$, presenting the product of the effect of striving on investment knowledge (a_{21} in equation 3) and the effect of investment knowledge on liquid wealth controlling for striving (b_{21} in equation 4).

Similarly, to test **H2b**, the relationship between evaluative concern and liquid wealth, one estimates investment knowledge from perfectionism,

$$Invest\_know_i = a_{22} Evaluative_i + Striving_{\ i}\varphi + X_i\gamma + \alpha_i \quad (5)$$

Liquid wealth is then estimated from both evaluative concern and investment knowledge:

$$Liq\_assest_i = c'_{22} Evaluative_i + b_{22} Invest\_know_i + Striving_i\varphi' + X_i\gamma' + \alpha_i' \quad (6)$$

The direct effect of evaluative concerns on liquid wealth is estimated with c'_{22} in equation (6). This parameter measures how much two cases differing in evaluative concerns by one unit are estimated to differ in liquid wealth independent of the effect of investment knowledge on liquid wealth. The *indirect effect* of evaluative concerns on liquid wealth through investment knowledge is estimated by $a_{22} \times b_{22}$, which presents the product of the effect of evaluative concerns on investment knowledge (a_{22} in equation 5) and the effect of investment knowledge on liquid wealth while controlling for striving (b_{22} in equation 6).

Table 3.2 lists the series of regressions for mediation analysis, which is sourced from Baron and Kenny (1986)

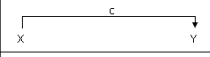
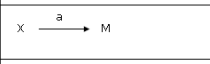
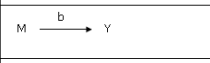
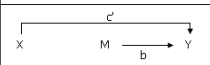
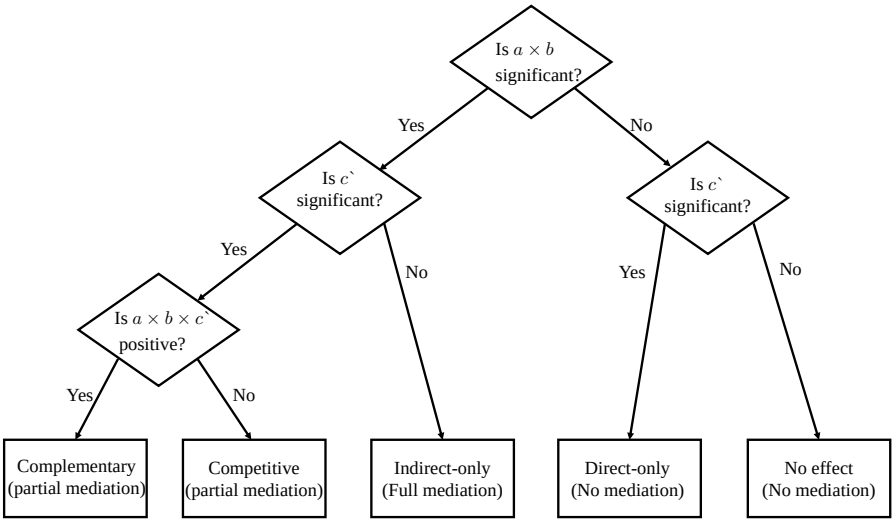
	Analysis	*Visual Depiction*
Step 1	Conduct a simple regression analysis with X predicting Y to test for path *c* alone, $Y = B_0 + B_1X + e$	
Step 2	Conduct a simple regression analysis with X predicting M to test for path *a*, $M = B_0 + B_1X + e$.	
Step 3	Conduct a simple regression analysis with M predicting Y to test the significance of path *b* alone, $Y = B_0 + B_1M + e$.	
Step 4	Conduct a multiple regression analysis with X and M predicting Y, $Y = B_0 + B_1X + B_2M + e$	

Figure 3.5 describes the procedures that I follow for the mediation test proposed by Zhao et al. (2010).



I diagnose whether there is a mediation effect following the decision tree proposed by Zhao et al. (2010), which is presented in Figure 3.5. I explain the logic behind this decision tree. In particular, the first step is to examine whether indirect effect $\mathrm{a} \times \mathrm{b}$ is significant (heading to mediation branch (left)) or not (heading to non-mediation branch (right)) by bootstrap test in Figure 3.5. No matter whether indirect effect is significant, the second step is to test the significance of direct effect (c'). By taking these two steps, it will identify the type of mediation or non-mediation:

1. When $\mathrm{a} \times \mathrm{b}$ is significant but c' is non-significant, it indicates full mediation.
2. When $\mathrm{a} \times \mathrm{b}$ and c' are significant, if the sign of $\mathrm{a} \times \mathrm{b} \times \mathrm{c}'$ by multiplying the three coefficients is positive, it indicates complementary mediation; otherwise, it indicates competitive mediation.
3. When $\mathrm{a} \times \mathrm{b}$ is not significant but c' is significant, it indicates there is no mediation effect, but only direct effect.
4. When neither $\mathrm{a} \times \mathrm{b}$ nor c' is significant, there is neither mediation nor direct effect.

Consequently, if I detected any mediation effect, I will proceed to the bootstraps test, as proposed by Preacher and Hayes (2004; 2008), to verify the significance of the indirect effect ($a \times b$). In contrast to the Sobel test (1982), this test does not require a sampling distribution of the indirect effect to be normal, and it is more powerful (MacKinnon et al., 2004; Williams and MacKinnon, 2008). I perform the bootstrap tests in SPSS Process.

3.4.3 Investment knowledge and liquid wealth as sequential mediators of the relationship between perfectionism and financial risk tolerance (H3)

The third objective of this paper is to investigate whether investment knowledge and liquid wealth serially mediate the relationship between perfectionism and financial risk tolerance. To test **H3a**, I employ a multiple mediators model. The *direct effect* and *indirect effects* of striving on financial risk tolerance are estimated from three equations (Hayes et al., 2011; Taylor et al., 2008): two for the mediators (investment knowledge and liquid wealth) and one for outcome (financial risk tolerance):

$$Invest\_know_i = a_{31} Striving_i + Evaluative_i \varphi + X_i \gamma + \alpha_i \quad (7)$$

$$Liq\_asset_i = a_{32} Striving_i + Evaluative_i \varphi' + a_{33} Invest\_know_i + X_i \gamma' + \alpha_i' \quad (8)$$

$$FRT_i = c'_{31} Striving_i + Evaluative_i \varphi'' + b_{31} Invest_{know_i} + b_{32} Liq_{asset_i} + X_i \gamma'' + \alpha_i'' \quad (9)$$

where the direct effect of striving on financial risk tolerance is c'_{31} in equation 9. In this model, there are three indirect effects: one through investment knowledge only ($a_{31} \times b_{31}$), one through liquid wealth only ($a_{32} \times b_{32}$), and one through investment knowledge followed by

liquid wealth ($a_{31} \times a_{33} \times b_{32}, \mathbf{Hypothesis\ 3a}$). I use the bootstraps test to examine the significance of these indirect effects.

Similarly, to test **H3b**, I have a multiple mediators model in which the *direct effect* and the *indirect effects* of evaluative concerns on financial risk tolerance are estimated from three equations, two for the mediators (investment knowledge and liquid wealth) and one for the outcome (financial risk tolerance):

$$Invest\_know_i = a_{41} Evaluative_i + Striving_i \varphi + X_i \gamma + \alpha_i \quad (10)$$

$$Liq\_asset_i = a_{42} Evaluative_i + Striving_i \varphi' + a_{43} Invest\_know_i + X_i \gamma' + \alpha_i' \quad (11)$$

$$FRT_i = c'_{41} Striving_i + Evaluative_i \varphi'' + b_{41} Invest_{know_i} + b_{42} Liq_{asset_i} + X_i \gamma'' + \alpha_i'' \quad (12)$$

where the direct effect of striving on financial risk tolerance is c'_{41} in equation 9. In this model, there are three indirect effects, one through investment knowledge only ($a_{41} \times b_{41}$), one through liquid wealth only ($a_{42} \times b_{42}$), and one through both investment knowledge and liquid wealth ($a_{41} \times a_{43} \times b_{42}, \mathbf{Hypothesis\ 3b}$). I use the bootstrap tests to examine the significance of these indirect effects.

3.4.4 The link between perfectionism and monthly gambling behaviour (H4)

The final objective of this paper is to examine, in the gambling subsample, whether perfectionism affects monthly input into gambling. I use OLS regression and quantile regression, as the benchmark techniques. In particular, the OLS technique verifies the relationship between one or more independent variables and the conditional mean of the dependent variable. Quantile regressions, as proposed by Koenker and Bassett (1978), develop the regression model to estimate the conditional quantiles of the dependent variable. This method is preferable when there is heteroscedasticity in the dataset. Quantile regressions are also useful to increase the degree of robustness of the results. They are independent of the assumptions of normal distribution of the error term and are robust when there are outliers in the dependent variable. I use 10th, 25th, 50th, 75th, and 90th quantile regressions, and I examine the significance of the estimators by applying bootstrapped standard errors based on 1000 replications.

The OLS model is specified as follows:

$$Monthly\_Gambling_i = Striving_i \beta + Evaluative_i \varphi + X_i \gamma + \alpha_i \quad (13)$$

where $Monthly\_Gambling_i$ denotes the logarithm of monthly expenditure on gambling of individual i. $Striving_i$ denotes the level of the positive aspect of perfectionism of individual i. $Evaluative_i$ represents the level of the negative aspect of perfectionism of individual i. X_i is a vector of control variables, including gender, age, employment status, educational

attainment, race, religion, annual household income, number of dependent children, marital status, liquid wealth, self-reported investment knowledge, financial risk tolerance and financial literacy. α_i indicates the error term.

I fit the following quantile model:

$$Month\_Gambling_i(\tau) = Striving_i\beta(\tau) + Evaluative_i\varphi(\tau) + X_i\gamma(\tau) + \alpha_i(\tau) \quad (14)$$

where $Month\_Gambling_i(\tau)$ is the τth conditional quantile of the logarithm of individual i`s monthly expenditure on gambling. $\beta(\tau)$ ($\varphi(\tau)$) is the corresponding coefficient of the level of the positive (negative) aspect of perfectionism of individual i at the τth conditional quantile. $\gamma(\tau)$ is a vector of coefficients of control variables at the τth conditional quantile. Furthermore, $\alpha_i(\tau)$ indicates the τth conditional quantile of the error terms.

3.5 Results

3.5.1 Perfectionism as a predictor of individual financial risk (H1)

Table 3.3 reports the coefficients in the OLS and quantile regressions. Figure 3.6 plots the differences in coefficients in the two regression techniques in terms of curves. The dashed line shows the estimated effect of striving (average) on financial risk tolerance from the OLS regression. The red solid line depicts the corresponding effects of striving (average) on financial risk tolerance from the quantile regression in different quantiles. The blue shaded bands represent the relevant 95-percent confidence intervals based on 1,000 bootstrap replications. I find that the coefficients before (after) quantile regression are smaller (greater) than the coefficient of OLS regression. In addition, the estimators of evaluative concerns are not significant in either the quantile regressions or OLS regression. Some of the control variables predict financial risk tolerance. For instance, compared with females, males tend to have a higher level of financial risk tolerance. Older people tend to tolerate less financial risk than younger people do. Moreover, financial literacy and employment are both positive predictors of financial risk tolerance. To investigate the effect of perfectionism on financial risk tolerance in different groups of people, Table 3.4 shows the estimations for six demographic subsamples that are divided by gender, age≥55 years old, and employment status. In particular, the positive association between striving (striving) and financial risk tolerance is consistently significant across these subgroups. Second, there is still no effect of evaluative concerns (average) on financial risk tolerance. Therefore, in general, the results in Table 3.4 are consistent with the results in Table 3.3, which support striving (average) as a positive predictor of financial risk tolerance (H1a) but do not support evaluative concerns (average) as a determinant (H1b).

Table 3.3. The results of a quantile regression and OLS regressions regarding the effect of perfectionism on financial risk tolerance in the entire sample.

	Quantile regressions					
	10%	25%	50%	75%	90%	OLS
Main effect						
Striving (average)	0.877**	0.685**	0.809***	0.943***	1.488***	0.938***
	(0.315)	(0.282)	(0.280)	(0.333)	(0.394)	(0.200)
Evaluative Concerns (average)	-0.076	-0.077	-0.199	-0.196	0.203	-0.113
	(0.385)	(0.250)	(0.365)	(0.408)	(0.504)	(0.231)
Control effect						
Male	1.182*	1.371***	2.122***	2.081***	2.002***	1.721***
	(0.628)	(0.502)	(0.523)	(0.620)	(0.700)	(0.371)
Age	-0.618**	-0.712***	-0.880***	-0.949***	-1.129***	-0.886***
	(0.289)	(0.274)	(0.222)	(0.264)	(0.349)	(0.178)
Employment	1.450	1.842***	1.852***	1.691	0.663	1.364**
	(0.853)	(0.683)	(0.619)	(0.755)	(0.954)	(0.471)
Education	0.304*	0.289	0.254	0.275	0.092	0.222**
	(0.201)	(0.181)	(0.166)	(0.220)	(0.276)	(0.136)
White_race	-0.060	-0.963**	-1.008*	0.462	0.372	-0.376
	(1.005)	(0.897)	(0.606)	(0.680)	(1.016)	(0.498)
Religion	-0.518	-0.658	-0.435	-0.042	-0.278	-0.360
	(0.603)	(0.525)	(0.503)	(0.660)	(0.719)	(0.378)
Annual_hincome	0.104	0.007	0.306	-0.182	-0.522	0.004
	(0.289)	(0.286)	(0.273)	(0.458)	(0.356)	(0.210)
No_dep	0.148	0.103	-0.029	0.039	0.362	0.086
	(0.221)	(0.190)	(0.217)	(0.236)	(0.320)	(0.142)
Marital_status	0.314	-0.347	-0.660	0.232	0.535	-0.171
	(0.636)	(0.543)	(0.492)	(0.607)	(0.824)	(0.382)
Log_Liq_asset	0.176**	0.166***	0.096	0.038	0.170*	0.129***
	(0.075)	(0.056)	(0.064)	(0.096)	(0.010)	(0.048)
Investment knowledge	0.304	0.683***	1.101***	0.934***	0.616*	0.741***
	(0.362)	(0.242)	(0.224)	(0.283)	(0.337)	(0.170)
Pseudo R2 (R2 in OLS)	0.181	0.197	0.196	0.170	0.181	0.297
Number of observations	661	661	661	661	661	661

Note: The dependent variable is financial risk tolerance (FRT). This table reports the coefficients of the quantile regression and OLS regression regarding the effect of striving and evaluative concerns on FRT. For the quantile regression, bootstrapped standard errors are in parentheses for 1,000 bootstrap replications. For the OLS regression, the robust standard errors are in parentheses. *, **, and *** indicate significance at the 10% level (2-sided), 5% level, and 1% level, respectively.

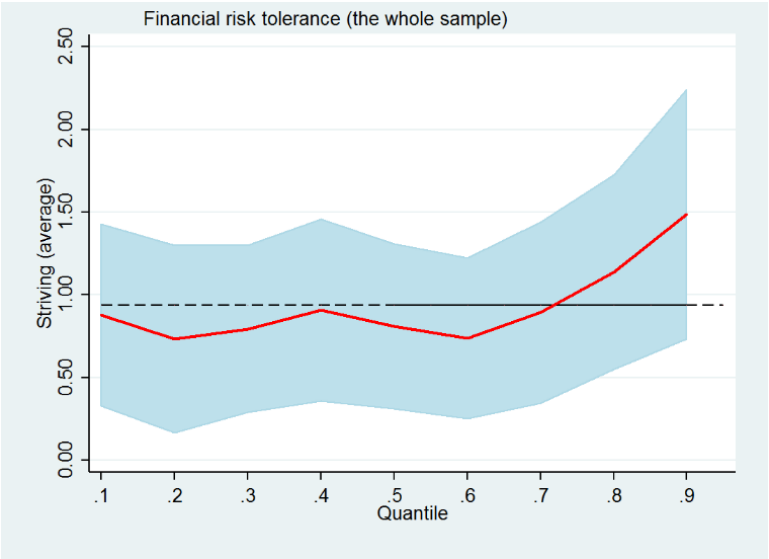


Figure 3.6 The impact of perfectionistic striving on financial risk tolerance, in terms of the coefficients of OLS and quantile regressions. The dashed line shows the estimated effect of striving on financial risk tolerance from the OLS regression. The red solid line depicts the corresponding effects of striving on financial risk tolerance from the quantile regression in different quantiles. The blue shaded bands present the corresponding 95-percent confidence intervals based on 1,000 bootstrap replications.

Table 3.4. OLS regression results regarding the effect of perfectionism on financial risk tolerance in the different demographic subgroups.

	OLS					
	Male	Female	Age≥55	Age<55	Employed	Unemployed
Main effect						
Striving (average)	0.919***	0.952***	0.925***	0.958***	0.819***	1.247***
	(0.378)	(0.239)	(0.302)	(0.267)	(0.233)	(0.387)
Evaluative Concerns (average)	0.011	-0.238	-0.060	-0.194	-0.253	0.004
	(0.491)	(0.265)	(0.351)	(0.310)	(0.274)	(0.454)
Control effect						
Male			1.878***	1.566***	1.658***	1.576**
			(0.492)	(0.568)	(0.470)	(0.625)
Age	-0.547*	-1.095***	-0.130***	-0.509	-1.063***	-0.494
	(0.317)	(0.205)	(0.336)	(0.403)	(0.206)	(0.352)
Employment	1.493*	1.163*	0.917*	-2.500*		
	(0.781)	(0.596)	(0.517)	(1.461)		
Education	0.177	0.236*	0.105	0.281	0.301*	0.063
	(0.248)	(0.164)	(0.178)	(0.210)	(0.179)	(0.220)
White_race	-0.447	-0.376	-0.642	-0.297	-0.153	-1.031
	(0.929)	(0.606)	(0.838)	(0.631)	(0.567)	(1.058)
Religion	0.116	-0.623	-0.711	-0.015	0.110	-1.486**
	(0.645)	(0.479)	(0.551)	(0.519)	(0.445)	(0.737)
Annual_hincome	-0.276	0.176	0.095	-0.350	-0.165	0.128
	(0.416)	(0.220)	(0.253)	(0.345)	(0.269)	(0.300)
No_dep	0.427	-0.045	0.176	-0.081	-0.005	0.654
	(0.331)	(0.153)	(0.235)	(0.189)	(0.153)	(0.403)
Marital_status	-0.709	-0.092	-0.333	0.151	-0.301	0.508
	(0.810)	(0.446)	(0.508)	(0.576)	(0.473)	(0.667)
Log_liq_asset	0.096	0.140***	0.086	0.218***	0.179***	0.057***
	(0.104)	(0.053)	(0.063)	(0.076)	(0.064)	(0.073)
Investment knowledge	1.066	0.573***	0.958***	0.504**	0.581***	1.117***
	(0.279)	(0.211)	(0.260)	(0.236)	(0.201)	(0.336)
R^2	0.271	0.311	0.234	0.181	0.219	0.245
Number of observations	221	440	360	301	424	237

Note: The dependent variable is financial risk tolerance (FRT). This table reports the coefficients of the OLS regression regarding the effect of striving and evaluative concerns on FRT in different demographic subgroups, which include males and females, aging and non-aging, and employed and non-employed. Robust standard errors are in parentheses. *, **, and *** indicate significance at the 10% level (2-sided), 5% level, and 1% level, respectively.

3.5.2 Investment knowledge as a mediator between perfectionism and liquid wealth (H2)

OLS regression analyses were conducted to investigate the mediation effect of investment knowledge on the relationship between striving (average) and the accumulation of liquid assets. The overall regression model is statistically significant (R^2=0.179, F[648]=11.702, p<0.001). First, striving (average) is positively associated with investment knowledge (path a: coefficient is 0.208, SE=0.048, and p<0.001). Second, investment knowledge is positively associated with the relationship between striving and liquid assets (path b: coefficient is 1.035, SE=0.140, p<0.001). The significance of a-path and b-path implies that there is a mediation effect. To further test the significance of this mediation effect (indirect effect a*b), I use the bootstrapping method with bias-corrected confidence estimates (Preacher and Hayes, 2004). The 95% confidence interval of the indirect effect is taken with 5000 bootstraps resamples (Preacher and

Hayes, 2008). If the confidence intervals of estimators do not contain 0, the indirect effect is significantly different from zero. The results of the bootstrap test suggest that investment knowledge mediates the link between striving and liquid wealth (indirect effect=a*b=0.208*1.035=0.216, SE=0.057, CI = from 0.119 to 0.343). In addition, the total effect (path c=0.443, SE=0.182, p=0.015) is significant, while the direct effect (path c`=0.216, SE=0.177, p=0.199) turns to be non-significant, indicating that this is a full mediation effect. Therefore, I can conclude that investment knowledge fully mediates the relationship between striving and liquid wealth. Figure 3.7 displays the corresponding results.

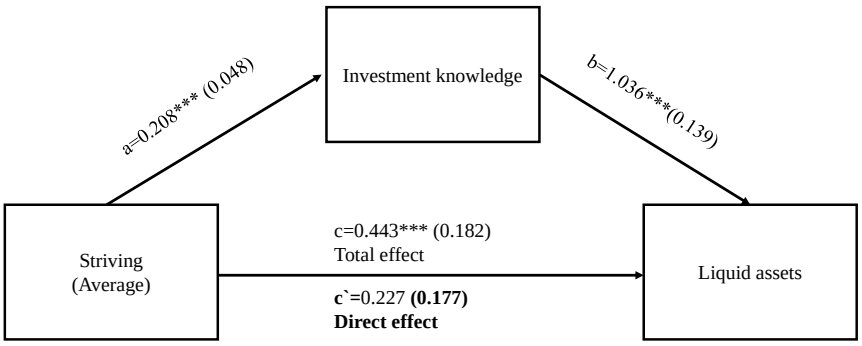


Figure 3.7 Investment knowledge mediates the relationship between striving (average) and liquid wealth (N=661)

Note: The indirect effect of striving on liquid assets through investment knowledge is statistically significant (a*b= 0.215, SE=0.057, 95% CI=[0.119, 0.343]). Bootstrapped resample is 5,000. *p<0.10,**p<0.05, ***p<0.01.

Similarly, OLS regression was conducted to investigate the mediation effect of investment knowledge on the relationship between evaluative concerns (average) and the accumulation of liquid wealth. The overall regression model is statistically significant (R^2=0.357, F[647]=30.153, p<0.001). First, evaluative concerns (average) are negatively associated with investment knowledge (path a: coefficient is -0.108, SE=0.054, and p<0.001). Second, investment knowledge is positively associated with the monthly input into gambling (path b: coefficient is 1.035, SE=0.140, p<0.001). Because a-path and b-path are significant, this indicates that there is a mediation effect. I use the bootstrapping method with percentile confidence estimates (Preacher and Hayes, 2004). The 95% confidence interval of the indirect effect is analysed with 10,000 bootstrap resamples (Preacher and Hayes, 2008). The results of the bootstrap test suggest that investment knowledge mediates the link between evaluative concerns and liquid assets (indirect effect=a*b=-0.108*1.035=-0.112, SE=0.057, CI = from -0.231 to -0.004). In addition, the total effect (path c=-0.051, SE=0.196, p=0.793) and the direct effect (path c`=0.061, SE=0.177, p=0.743) are non-significant, indicating that this is a full mediation effect. Therefore, I can conclude that investment knowledge fully mediates the relationship between evaluative concerns and liquid wealth. Figure 3.8 displays the corresponding results.

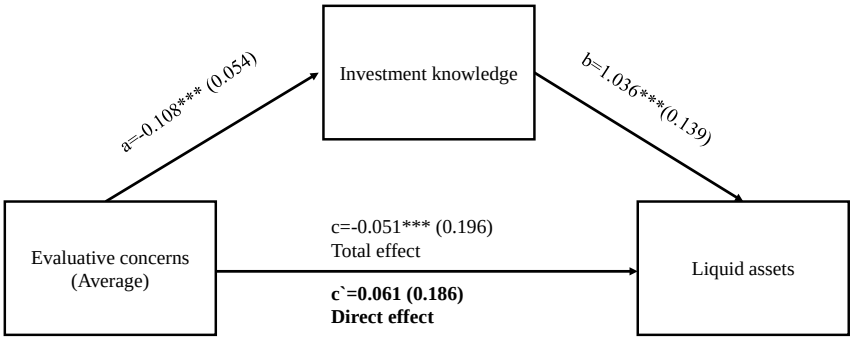


Figure 3.8 Investment knowledge mediates the relationship between evaluative concerns (average) and liquid wealth (N=661)

Note: The indirect effect of evaluative concerns on liquid assets through investment knowledge is statistically significant (a*b=-0.112, SE=0.057, 95% CI=[-0.231, -0.004]. Bootstrapped resample is 5,000. *p<0.10,**p<0.05, ***p<0.01.

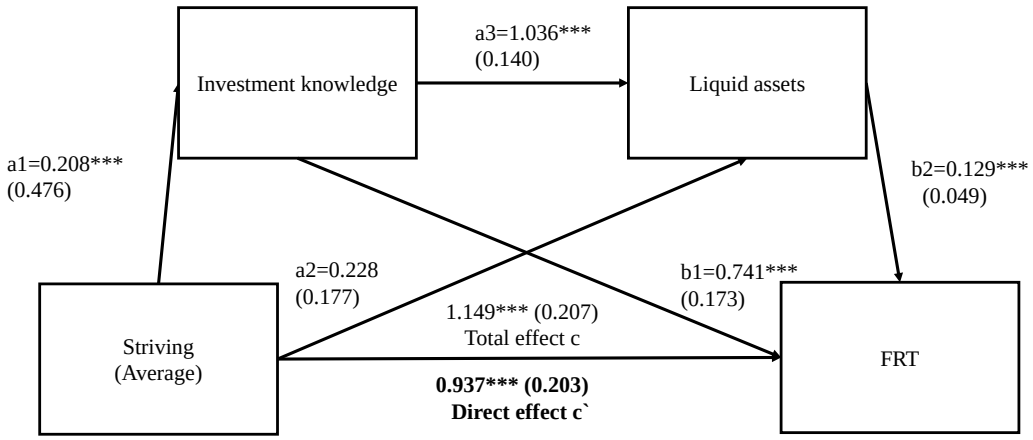
In summary, the indirect effect (0.215) between striving and liquid assets via investment knowledge is positive and significant, which supports H2a. This finding means that the log of liquid assets is expected to increase by 0.215 units for every one-unit increase in striving (average) (1 to 5 scale). Meanwhile, the indirect effect (-0.112) between evaluative concerns and liquid assets via investment knowledge is negative and significant, which supports H2b. This finding indicates that the log of liquid assets is expected to decrease by 0.112 units for every one-unit increase in evaluative concerns (average) (1 to 5 scale). Comparing the absolute magnitudes, I conclude that the indirect effect of perfectionistic striving on liquid wealth is higher than the indirect effect of perfectionistic evaluative concerns on liquid wealth.

3.5.3 Investment knowledge and liquid wealth as serial mediators between perfectionism and financial risk tolerance (H3)

Figure 3.9 displays the path coefficients from the bootstrapped regressions and mediation analyses for the effects of striving on financial risk tolerance through the sequential path of investment knowledge followed by liquid wealth. The overall regression model is statistically significant (R^2=0.179, F[649]=11.702, p<0.001). Specifically, striving (average) predicts investment knowledge (a1=0.208, SE=0.048, p<0.001), investment knowledge significantly predicts liquid wealth (a3=1.036, SE=0.140, p<0.001), and liquid wealth significantly predicts financial risk tolerance (b2=0.129, SE=0.049, p=0.009). In this model, the direct effect of striving on financial risk tolerance remains significant (c`=0.937, SE=0.203, p<0.001). Importantly, the sequential indirect effects of investment knowledge and liquid wealth on the association between striving and financial risk tolerance are statistically significant (a1*a3*b2=0.028, SE=0.013, bootstrapped 95% CI is from 0.007 to 0.062). This result suggests that perfectionistic striving is associated with increased investment knowledge, which is associated with increased liquid wealth and which in turn is associated with increased financial risk tolerance. Since the sequential indirect effect (a1*a3*b2) and direct effect (c`) are

significant, the results indicate that the link between striving and financial risk tolerance is partially mediated by investment knowledge and liquid wealth, which supports H3a. In addition, the indirect effect of investment knowledge on the association between striving and financial risk tolerance is significant (a1*b1=0.154, SE=0.521, bootstrapped 95% CI is from 0.072 to 0.282), which indicates that investment knowledge partially mediates the relationship between striving and financial risk tolerance. However, liquid wealth does not mediate the relationship between striving and financial risk tolerance (a2*b2=0.029, SE=0.026, bootstrapped 95% CI is from -0.007 to 0.104). Finally, the magnitude of the direct effect (c`=0.937) is much greater than the magnitudes of the two indirect effects (a1*a3*b2=0.028 and a1*b1=0.154).

Figure 3.9. Investment knowledge and liquid wealth sequentially mediate the relationship between striving and financial risk tolerance. Investment knowledge mediates the relationship between striving and financial risk tolerance. Striving directly increases financial risk tolerance (N=661).



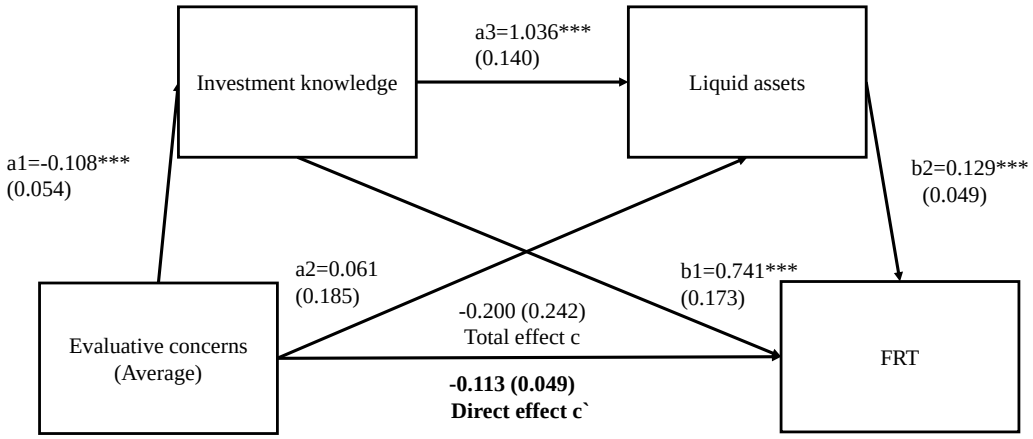
Note. The sequential indirect effects of striving and financial risk tolerance through investment knowledge and liquid wealth is statistically significant (a1*a3*b2= 0.028, SE=0.013, bootstrapped 95% CI= [0.007, 0.062]). The indirect effect of striving on financial risk tolerance through investment knowledge is statistically significant (a1*b1= 0.154, SE=0.521, bootstrapped 95% CI is from 0.072 to 0.282). The direct effect of striving on financial risk tolerance is statistically significant (c`=0.937, SE=0.203, p<0.001). *p<0.10, **p<0.05, ***p<0.01.

Figure 3.10 displays the path coefficients from the bootstrapped regressions and mediation analyses for the effects of evaluative concerns on financial risk tolerance through the sequential path of investment knowledge followed by liquid wealth. The overall regression model is statistically significant (R^2=0.179, F[648]=11.703, p<0.001). Specifically, evaluative concerns (average) negatively predict investment knowledge (a1=-0.108, SE=0.054, p=0.048), investment knowledge significantly predicts liquid wealth (a3=1.036, SE=0.140, p<0.001), and liquid wealth significantly predicts financial risk tolerance (b2=0.129, SE=0.049, p=0.009). In this model, the direct effect of evaluative concerns on financial risk tolerance is not statistically significant (c`=-0.113, SE=0.235, p=0.632). However, importantly, the sequential indirect effects of investment knowledge and liquid wealth on the association between evaluative concern and financial risk tolerance are statistically significant (a1*a3*b2=-0.015, SE=0.009,

bootstrapped 95% CI is from -0.043 to -0.002). This result indicates that evaluative concerns are associated with decreased investment knowledge, which is associated with decreased liquid wealth and which in turn is associated with decreased financial risk tolerance. Given a significant sequential indirect effect (a1*a3*b2) but the lack of a direct effect (c`), the results indicate that the link between evaluative concerns and financial risk tolerance is fully mediated by investment knowledge and liquid wealth, which supports H3b. In addition, the indirect effect of investment knowledge on the association between evaluative concerns and financial risk tolerance is significant (a1*b1=-0.080, SE=0.044, bootstrapped 95% CI is from -0.187 to -0.009), suggesting that investment knowledge fully mediates the link between evaluative concerns and financial risk tolerance. The indirect effect of liquid wealth on the relationship between evaluative concerns and financial risk tolerance is not significant (a2*b2=0.008, SE=0.026, bootstrapped 95% CI is from -0.039 to 0.069).

To summarize, although both perfectionistic striving and perfectionistic concerns can indirectly predict financial risk tolerance through investment knowledge alone and investment knowledge followed by liquid wealth, the magnitudes of the indirect effects on FRT are mild.

Figure 3.10. Investment knowledge and liquid wealth sequentially mediate the relationship between evaluative concerns and financial risk tolerance. Investment knowledge mediates the relationship between evaluative concerns and financial risk tolerance. (N=661).



Note. The sequential indirect effects of evaluative concerns on financial risk tolerance through investment knowledge and liquid wealth is statistically significant (a1*a3*b2= -0.015, SE=0.010, bootstrapped 95% CI= [-0.043, -0.002]). The indirect effect of evaluative concerns on financial risk tolerance through investment knowledge is statistically significant (a1*b1= -0.080, SE=0.044, bootstrapped 95% CI is from -0.187 to -0.009). *p<0.10, **p<0.05, ***p<0.01.

3.5.4 Perfectionism as a predictor of monthly gambling expenditures (H4)

Table 3.5 reports the estimates of the OLS regression regarding the relationship between perfectionism and monthly input into gambling, along with estimates for quantiles $\tau \in \{0.10, 0.35, 0.50, 0.70, 0.90\}$ to examine Hypothesis 4 for the gambling group (N=225). Throughout

this subsection, the dependent variable is the logarithm of monthly income spent on gambling. The independent variables are striving (average) and evaluative concerns (average), which represent the positive facet and the adverse facet of perfectionism, respectively. In particular, the average marginal effects of evaluative concerns (average) are negatively significant in all quantiles and OLS regressions. The average magnitude of these coefficients is approximately 0.35, which means that log-transformed monthly spending on gambling is reduced by approximately 35% for a one-unit increase in evaluative concerns (average) (5-point scale) when all other variables are held constant. However, I do not find that striving (average) can predict the variance in log-transformed monthly expenditures on gambling because almost no corresponding coefficient is statistically significant. Therefore, the results support Hypothesis H4a but do not support Hypothesis H4b.

Table 3.5 reports the average marginal effects of perfectionism on the logarithm of the monthly input into gambling among people who have participated in gambling.

Dependent variables: Log (Monthly spending on gambling)	Quantile regressions					
	10%	35%	50%	70%	90%	OLS
Main effect						
Evaluative	-0.141*	-0.291**	-0.318**	-0.484***	-0.585*	-0.339**
concern (average)	(0.073)	(0.139)	(0.131)	(0.183)	(0.320)	(0.144)
Striving (average)	-0.032	-0.023	-0.304**	-0.152	0.172	-0.033
	(0.087)	(0.174)	(0.149)	(0.142)	(0.303)	(0.164)
Control effect						
Age	0.069	-0.201	-0.182*	-0.113	-0.054	-0.102
	(0.073)	(0.134)	(0.102)	(0.169)	(0.288)	(0.132)
Male	0.197	0.144	0.279	0.282	0.570	0.239
	(0.153)	(0.237)	(0.213)	(0.302)	(0.533)	(0.249)
Marital status	0.053	-0.341	-0.227	-0.046	0.701	-0.130
	(0.152)	(0.260)	(0.277)	(0.289)	(0.815)	(0.240)
Education	-0.235***	-0.053	-0.074	-0.106	-0.167	-0.072
	(0.055)	(0.096)	(0.083)	(0.081)	(0.258)	(0.098)
Employment	0.020	-0.484	-0.405	-0.342	-0.071	-0.225
	(0.224)	(0.326)	(0.340)	(0.358)	(0.679)	(0.296)
White_race	-0.191	-0.451	-0.618**	-0.535*	-0.219	-0.274
	(0.239)	(0.394)	(0.252)	(0.301)	(0.732)	(0.339)
Religion	-0.110	-0.314	-0.212	-0.245	0.955*	0.061
	(0.155)	(0.273)	(0.216)	(0.269)	(0.532)	(0.235)
No_dep	0.059	0.191*	0.153***	0.024	-0.068	0.053
	(0.058)	(0.109)	(0.053)	(0.094)	(0.249)	(0.080)
Annual_hincome	0.038	0.122	-0.112	0.069	0.022	0.053
	(0.068)	(0.183)	(0.140)	(0.115)	(0.516)	(0.114)
Log_liq_asset	0.049	0.086***	0.967***	0.070	0.042	0.071**
	(0.035)	(0.026)	(0.037)	(0.046)	(0.094)	(0.030)
Investment	0.265***	0.078	0.024	0.055	0.031	0.010
knowledge	(0.064)	(0.110)	(0.093)	(0.141)	(0.228)	(0.117)
FRT	0.076***	0.069**	-0.062***	-0.036***	0.143**	0.078***
	(0.015)	(0.027)	(0.022)	(0.032)	(0.060)	(0.027)
FL	-0.148***	-0.168***	-0.148***	-0.102	-0.171	-0.144***
	(0.034)	(0.047)	(0.045)	(0.065)	(0.124)	(0.052)
Pseudo R2 (R2 in OLS)	0.149	0.104	0.114	0.108	0.143	0.174
Number of observations	225	225	225	225	225	225

Note: The dependent variable is the log transformation of the monthly input into gambling. This table reports the coefficients of the quantile regression and OLS regression regarding the effects of striving and evaluative concerns on the monthly input into gambling. The sample is the group of people who participate in gambling monthly. Robust standard errors are in parentheses, for both the quantile regression and OLS regression. *, **, and *** indicate significance at the 10% level (2-sided), 5% level, and 1% level, respectively.

3.5.5 Robustness check

The distributions of financial risk tolerance (FRT) theoretically range between 13 and 47. Therefore, modeling FRT is based on the configuration that the dependent variable is limited and the coefficients of the OLS regression may be biased (Heckman, 1979). I rescale FRT by subtracting 13 and dividing by 34, resulting in a proportion form of FRT that theoretically ranges from 0 to 1. Consequently, I use the fractional response model proposed by Papke and Wooldridge (1996) to predict fractional FRT, which can address the bias issue and be used to check the robustness of the significant findings for H1a and H1b. In addition, I add *Investment year* and *Log_loan* as additional control variables to reduce confounding effects. These variables denote the year of investment and the logarithm unit of the loan, respectively. *Investment year* is an integer ranging from 0 to 35. *Log_loan* is the logarithmic transformation of the loan, which is a non-negative continuous variable.

Table 3.6 presents the results of the fractional response model regarding the effect of perfectionistic striving and perfectionistic concerns on fractional FRT in different demographic groups. The average marginal effects of striving are all positive and significant, but evaluative concerns still do not explain the variance in fractional FRT. In particular, a 1% increase in perfectionistic striving (average) increases fractional FRT by approximately 0.037. These results are consistent with the results of the OLS and quantile regressions with regard to the effect of perfectionistic striving (average) on FRT, and support H1a but do not support H1b.

Table 3.6. The results of the fractional response model regarding the average marginal effects of perfectionism on fractional FRT in different demographic subgroups.

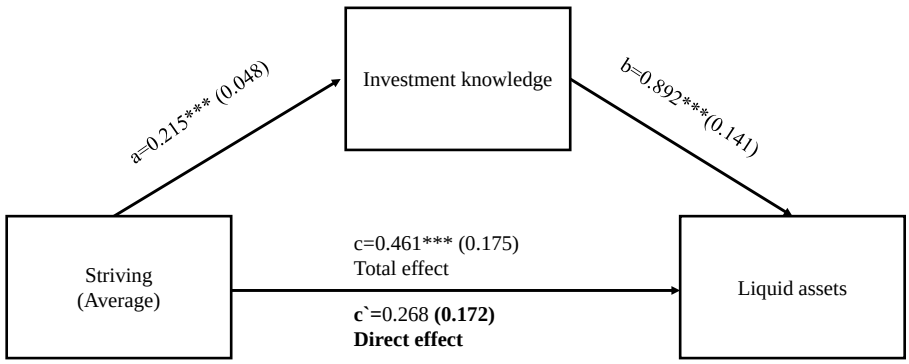
Dependent variable: Fractional FRT	Fractional response model						
	All	Male	Female	Age≥55	Age<55	Employed	Unemployed
Main effect							
Striving (Average)	0.029*** (0.006)	0.029*** (0.011)	0.029*** (0.007)	0.027*** (0.008)	0.031*** (0.008)	0.026*** (0.007)	0.037*** (0.011)
Evaluative concerns (Average)	-0.002 (0.006)	0.001 (0.014)	-0.005 (0.007)	-0.001 (0.010)	-0.006 (0.008)	-0.007 (0.008)	-0.002 (0.013)
Control effect							
Male	0.048*** (0.104)			0.049*** (0.014)	0.042** (0.016)	0.047*** (0.013)	0.038** (0.017)
Age	-0.022*** (0.005)	-0.012 (0.008)	-0.028** (0.006)	-0.003 (0.009)	-0.022* (0.013)	-0.028*** (0.006)	-0.016 (0.010)
Employment	0.036*** (0.010)	0.034 (0.022)	0.031* (0.018)	0.029** (0.014)	-0.074* (0.043)		
Education	0.005	0.005	0.004	0.001	0.006	0.007	-0.001

	(0.004)	(0.007)	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)
White_race	-0.015	-0.021	-0.014	-0.026	-0.012	-0.011	-0.039
	(0.014)	(0.025)	(0.016)	(0.023)	(0.018)	(0.016)	(0.028)
Religion	-0.013	0.002	-0.021	-0.021	-0.002	0.001	-0.043**
	(0.011)	(0.018)	(0.013)	(0.015)	(0.015)	(0.013)	(0.021)
Annual_hincome	-0.001	-0.007	0.004	0.001	-0.011	-0.006	0.003
	(0.006)	(0.011)	(0.006)	(0.007)	(0.009)	(0.007)	(0.008)
No_dep	0.002	0.014	-0.002	0.002	-0.002	0.001	0.009
	(0.004)	(0.009)	(0.004)	(0.006)	(0.005)	(0.004)	(0.010)
Marital_status	-0.006	-0.018	-0.005	-0.013	0.005	-0.010	0.001
	(0.011)	(0.023)	(0.013)	(0.014)	(0.017)	(0.014)	(0.019)
Log_liq_asset	0.003**	0.001	0.004**	0.001	0.006***	0.004**	-0.001
	(0.001)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Investment	0.019***	0.030***	0.013**	0.020***	0.012*	0.014**	0.024***
knowledge	(0.005)	(0.008)	(0.006)	(0.007)	(0.006)	(0.005)	(0.009)
Investment	0.002***	0.003**	0.003***	0.017***	0.002	0.002***	0.020***
year	(0.001)	(0.001)	(0.001)	(0.006)	(0.001)	(0.001)	(0.006)
Log_Loan	0.001	-0.001	0.002	0.002	-0.001	0.001	0.002
	(0.001)	(0.003)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)
Pseudo R2	0.026	0.021	0.026	0.020	0.011	0.224	0.024
The number of observations	661	221	440	360	301	424	237

Note: The dependent variable is fractional FRT. This table reports the average marginal effects of the fractional response model regarding the effects of striving (average) and evaluative concerns (average) on fractional FRT. Robust standard errors are in parentheses. *, **, and *** indicate significance at the 10% level (2-sided), 5% level, and 1% level, respectively.

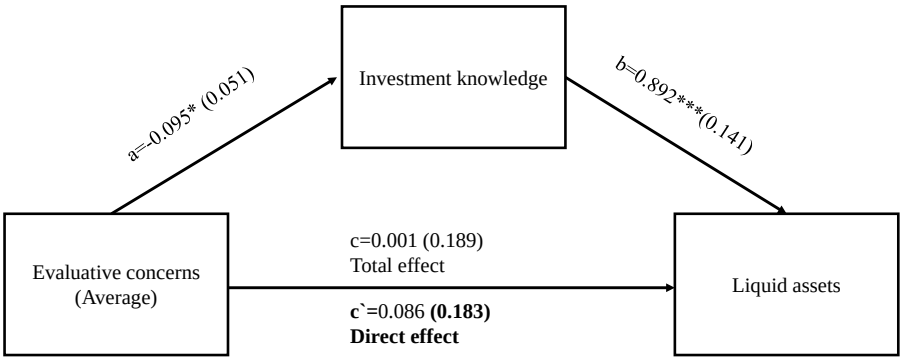
Second, I verify H2a and H2b with additional control variables (*Investment year* and *Log_loan*) and increase the number of bootstrap resamples from 5,000 to 20,000. Figure 3.11a and Figure 3.11b present the estimated coefficients, the standard errors in parentheses, and their level of significance (p-value) for the mediation analysis. OLS estimates all coefficients. The results are consistent with the benchmark results. In particular, the results of the bootstraps test in Figure 3.11a indicate that investment knowledge partially mediates the link between striving and liquid wealth (indirect effect=a*b=0.192, SE=0.049, 95% CI = from 0.108 to 0.307). The results of the bootstrap test in Figure 3.11b indicate that investment knowledge fully mediates the relationship between evaluative concerns and liquid assets (indirect effect=a*b=-0.085, SE=0.047, 95% CI = from -0.188 to -0.002).

Figure 3.11a. Investment knowledge mediates the relationship between striving (average) and liquid wealth. Bootstrapped resample increases from 5,000 to 20,000. (N=661)



Note: The indirect effect of striving on liquid assets through investment knowledge is statistically significant (a*b= 0.192, SE=0.049, 95% CI=[0.108, 0.307]). Bootstrapped resample raises from 5,000 to 20,000. *p<0.10,**p<0.05, ***p<0.01.

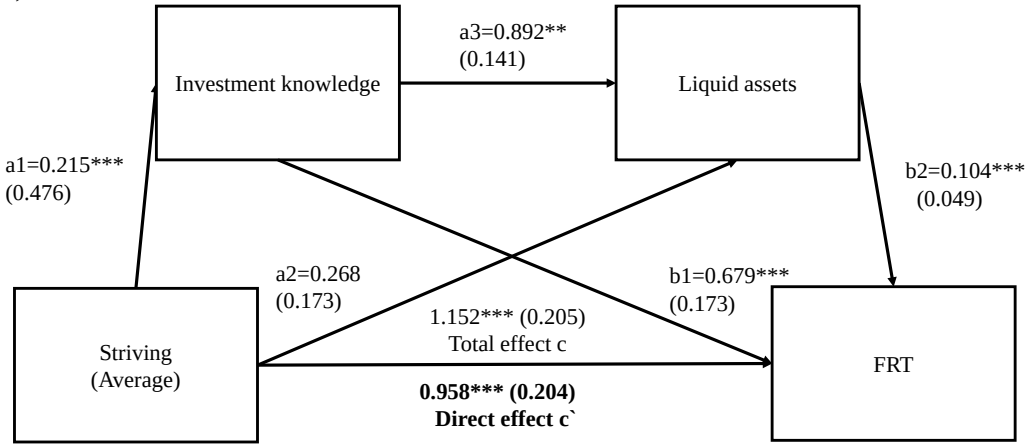
Figure 3.11b. Investment knowledge mediates the relationship between evaluative concerns (average) and liquid wealth. Bootstrapped resample increases from 5,000 to 20,000. (N=661)



Note: The indirect effect of evaluative concerns on liquid assets through investment knowledge is statistically significant (a*b= -0.085, SE=0.047, 95% CI=[0-.188, -0.002]). Bootstrapped resample raises from 5,000 to 20,000. *p<0.10,**p<0.05, ***p<0.01.

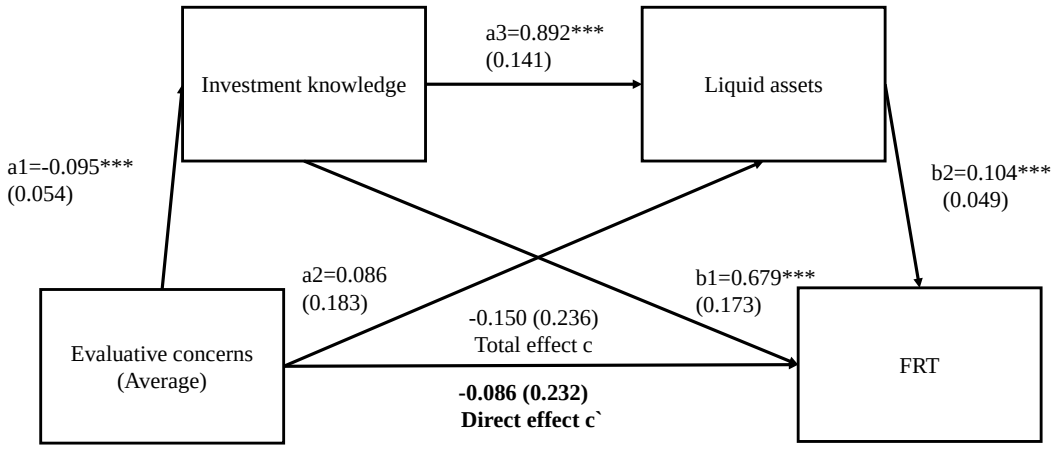
Third, I verify H3a and H3b with the new control variables and increase the number of bootstrap resamples to 20,000. Figure 3.12a (3.12b) displays the path coefficients from the bootstrapped regressions and mediation analyses for the effects of striving (evaluative concerns) on financial risk tolerance through a sequential path of investment knowledge followed by liquid wealth. All of these coefficients are estimated by OLS. I find that the results are consistent with the benchmark results.

Figure 3.12a. Investment knowledge and liquid wealth sequentially mediate the relationship between striving and financial risk tolerance. Investment knowledge mediates the relationship between striving and financial risk tolerance. Striving directly drives financial risk tolerance (N=661). Bootstrapped resample increases from 5,000 to 20,000.



Note. The sequential indirect effects of striving on financial risk tolerance through investment knowledge and liquid wealth is statistically significant (a1*a3*b2= 0.020, SE=0.011, bootstrapped 95% CI= [0.003, 0.048]). Bootstrapped resample raises from 5,000 to 20,000. The indirect effect of striving on financial risk tolerance through investment knowledge is statistically significant (a1*b1= 0.146, SE=0.056, bootstrapped 95% CI is from 0.065 to 0.269). The direct effect of striving on financial risk tolerance is statistically significant (c`=0.958, SE=0.204, p<0.001). *p<0.10, **p<0.05, ***p<0.01.

Figure 3.12b. Investment knowledge and liquid wealth sequentially mediate the relationship between evaluative concerns and financial risk tolerance. Investment knowledge mediates the relationship between evaluative concerns and financial risk tolerance. Bootstrapped resample increases from 5,000 to 20,000.



Note. The sequential indirect effects of evaluative concerns on financial risk tolerance through investment knowledge and liquid wealth is statistically significant (a1*a3*b2= -0.008, SE=0.068, bootstrapped 95% CI= [-0.029, -0.001]). Bootstrapped resample raises from 5,000 to 20,000. The indirect effect of evaluative concerns on financial risk tolerance through investment knowledge is statistically significant (a1*b1= -0.065, SE=0.038, bootstrapped 95% CI is from -0.157 to -0.004). *p<0.10, **p<0.05, ***p<0.01.

Table 3.7 reports the average marginal effects of perfectionism on the proportion of monthly income spent on gambling (fractional).

Dependent variable: Proportion of monthly income spent on gambling (fractional)	Fractional response model (the gambling sample)			
Variables	Average margin effect	SD	z-statistic	p-value
Main variables				
Striving (Average)	-0.006	0.008	-0.78	0.436
Evaluative concerns (Average)	-0.014**	0.007	-2.011	0.035
Control variables				
Age	-0.002	0.046	-0.34	0.736
Male	0.012	0.013	0.93	0.351
Marital status	0.002	0.012	0.16	0.871
Education	0.005	0.004	1.17	0.242
Employment	0.005	0.014	0.38	0.705
White_race	-0.005	0.015	-0.04	0.970
Religion	0.010	0.012	0.84	0.403
No_dep	0.005	0.004	1.28	0.201
Log_Annual_hincome	-0.038*	0.020	-1.85	0.064
Log_Loan	-0.002	0.001	-1.15	0.251
Log_liq_asset	0.002*	0.001	1.92	0.055
Investment knowledge	-0.002	0.001	-0.36	0.718
Investment year	0.001	0.001	0.13	0.896
FRT	0.004***	0.001	2.83	0.005
FL	-0.003	0.002	-1.12	0.265
Pseudo R2	0.085			
Number of observation	218			

Note: The dependent variable is the proportion of monthly income spent on gambling (fractional). This table reports the average marginal effects of the fractional response regression regarding the effect of striving and evaluative concerns on the proportion of monthly income spent on gambling. The sample is US residents randomly sampled from an online survey. Robust standard errors are in parentheses*, **, and *** indicate significance at the 10% level (2-sided), 5% level, and 1% level, respectively.

Finally, I use a relative measure of monthly expenditures on gambling, gambling expenditure share (Castrén et al., 2018), to conduct a robustness check on H4a and H4b. This measure is the proportion of monthly income spent on gambling, which ranges from 0 to 1. I exclude 7 outliers because their proportions of monthly income spent on gambling are greater than 1. Because the dependent variable is now fractional and my sample is cross-sectional, I use the fractional response model proposed by Papke and Wooldridge (1996).

$$Ratio_{Gambling} = \frac{Exp\left(Log(M_{Gambling})\right)}{Exp\left(Log(Annual_{Income}/12)\right)} \quad (15)$$

The estimates using a relative measure of monthly gambling expenditures are presented in Table 3.7, which shows that a 1% increase of evaluative concerns (averaged) decreases the proportion of monthly income spent on gambling by 0.014. Therefore, the results support H4a, indicating that perfectionistic concerns are negatively associated with the proportion of monthly income spent on gambling. By changing the measure of monthly gambling expenditures from the absolute form to the relative form and using a nonlinear model (fractional response model), the effect of perfectionistic concerns on monthly gambling expenditures remains. In addition, there is still no significance with regard to the effect of striving on the proportion of monthly income spent on gambling. Hence, H4b is not supported.

3.6 Discussion

In this section, I summarize the empirical findings. First, striving is positively associated with financial risk tolerance. Second, striving (evaluative concerns) is associated with increased (decreased) investment knowledge, which is then associated with increased (decreased) liquid wealth. Third, the absolute magnitude of the indirect effect of perfectionistic striving on liquid wealth is greater than that of evaluative concerns on liquid wealth. Subsequently, the relationship between striving and financial risk tolerance is complementarily mediated by investment knowledge. It is also serially mediated by investment knowledge and in turn liquid wealth. The magnitude of the direct effect is much larger than that of indirect effects. Furthermore, evaluative concerns are negatively associated with financial risk tolerance, and this association is mediated by investment knowledge itself and investment knowledge followed by liquid wealth. There is no direct effect of evaluative concerns on financial risk tolerance. Finally, among gamblers, evaluative concerns reduce monthly expenditures on gambling.

3.6.1 Perfectionism and financial risk tolerance

The results support H1a, which states that, among the general population, perfectionistic striving is positively associated with financial risk tolerance. This finding persists in different demographic subgroups, including males, females, aging people (age≥55), non-aging people, the employed, and the non-employed. However, the results do not indicate that perfectionistic concerns (negative reactions to imperfection) influence financial risk tolerance.

One of few studies that documents the relationship between perfectionism and risk attitude, Weller and Thulin (2012) report that a higher score on perfectionism is associated with less risk-taking to achieve gains. In other words, perfectionism is associated with risk tolerance of loss. However, their measure of perfectionism is based on Lee and Ashton (2004), who conceptualize perfectionism as socially prescribed perfectionism (or so-called perfectionistic concerns), which captures only the negative facet of multidimensional perfectionism. Therefore, Weller and Thulin (2012) do not study the effect of the positive aspect of perfectionism on individual risk attitudes, and we fill this gap by demonstrating that perfectionistic striving drives financial risk tolerance. Therefore, what might account for this relationship between striving and financial risk tolerance? By definition, perfectionism is a personality disposition described as striving for flawlessness and establishing high standards for performance, accompanied by a propensity for excessively critical evaluation of one`s actions (Flett and Hewitt, 2002). Therefore, it appears that the positive association between perfectionistic striving and financial risk tolerance may be due to the aim of achieving financial well-being, which is a key determinant of general life happiness (Kruger, 2011). Previous research has reported that adaptive forms of perfectionism are associated with higher levels of self-efficacy (Frost et al., 1990; Stoeber et al., 2008), whereas financial self-efficacy is positively associated with increased investment risk-taking (Montford and Goldsmith, 2016). Therefore, self-efficacy is one possible channel through which striving drives financial risk tolerance. By definition, self-efficacy is a person's beliefs about their capability to organize and execute courses of action to achieve a goal (Bandura, 1977); it appears to be an internal motivation and is one of the best predictors of successful performance across many areas (Marlatt, 1985). Self-efficacy increases individuals' confidence in their capacity to execute certain behaviours (Stajkovic and Luthans, 1998), and in particular, financial self-efficacy is positively associated with investment knowledge (Forbes and Kara, 2010). Consequently, people with confidence and investment knowledge tend to have a willingness to tolerate financial risk. Although allocating more savings to 'risky' investments such as stocks and less to 'safer' fixed income vehicles increases financial risk, it increases individual savings over the long run (Chatterjee et al., 2011) because these risky types of assets provide more long-term growth in portfolio value (Hickman et al., 2001). Because long-term portfolio growth results in positive capital income, I believe that it

can solidify an individual's financial situation. Hence, self-oriented perfectionism seeks financial-wellbeing.

The other channels may be individual characteristics. In particular, striving is associated with more pride after success (Stoeber et al., 2008a), and consequently, greater pride is associated with a higher level of confidence, which in turn may drive tolerance of financial risk when individuals make financial decisions. Stoeber et al. (2008) reveal that perfectionistic striving positively predicts the level of aspiration; and hence, increased aspiration causes higher risk tolerance (Audia and Greve, 2006). Moreover, Stoeber and Otto (2006) review the argument from the literature that striving is positively associated with extraversion, which is in turn associated with risk tolerance Filbeck et al. (2005). Finally, striving shows a positive relationship with endurance (Stoeber and Otto, 2006), and prime-age males have developed a greater risk-preference position (Halek and Eisenhaue, 2001).

However, why are perfectionistic concerns unable to predict the variability in financial risk tolerance? By definition, perfectionistic concerns are associated with critical self-evaluation, feelings of divergence between anticipations and outcomes, excessive concern about mistakes, and worrying about acceptance by others (Stoeber et al., 2008). Therefore, perfectionistic concerns are supposed to be negatively associated with financial risk tolerance as it relates to concerns about mistakes (Stoeber et al., 2008). However, the two facets of perfectionism do interact in concert (Brand and Altstötter-Gleich, 2008), and the positive facet may play the dominant role in sharpening risk tolerance.

I interpret this main finding regarding the relationship between perfectionistic striving and financial risk tolerance based only on theoretical justification and inferences from the literature. In the following part of this section, I will further present the empirical evidence to that supports the proposed channels through which both striving and evaluative concern may influence the level of financial risk tolerance.

3.6.2 Perfectionism, investment knowledge, and liquid wealth

The second finding is that striving (evaluative concerns) is associated with increased (decreased) investment knowledge, which is then associated with increased (decreased) liquid wealth. In other words, both striving and evaluative concerns indirectly affect liquid wealth through the channel of investment knowledge. I propose the following mechanism for the indirect relationship between perfectionism and liquid wealth. First, those with greater liquid wealth tend to have a more positive awareness of their financial well-being, which in turn drives life satisfaction (Ruberton et al., 2016). Second, common sense dictates that perfectionists seek to be perfect in all aspects of their lives, including investing and purchasing, which are found to

be correlated with self-oriented perfectionism (striving) (Stoeber and Stoeber, 2009). Nevertheless, Stoeber and Stoeber (2009) do not find that investing and purchasing are correlated with socially prescribed perfectionism (evaluative concerns). The finding is partially consistent with their finding, but with enhanced evidence in support of the relationship between perfectionism (both striving and evaluative concerns) and liquid wealth. First, they use the Spearman correlation to inspect this relationship, whereas I use regression models. Correlation is not a causal analysis, but regression is a statistical inference tool (Wermuth, 1980). Second, their results do not suggest that there is a negative correlation between perfectionistic concern and the investment domain, whereas I find that perfectionistic concerns lead to decreased investment knowledge, which further causes decreased liquid wealth.

Subsequently, I advance the discussion to explain the mechanism by which investment knowledge could mediate the relationship between perfectionism and liquid wealth. On the one hand, the results indicate that striving is positively associated with investment knowledge, whereas evaluative concerns are negatively related to investment knowledge. By definition, studying involves the acquisition of knowledge through reading, investigation, or practice. Therefore, it appears that striving (evaluative concerns) can facilitate (impede) the capabilities of studying, which in turn enhance the acquisition of knowledge. In the investment context, this finding is in line with previous research showing that perfectionistic striving is positively associated with studying, whereas perfectionistic concerns are negatively associated with studying. For example, Stoeber and Stoeber (2009) report that striving has a positive correlation with studying. Similarly, Accordino et al. (2000) provide empirical evidence to support that striving is positively associated with GPA. Grzegorek et al. (2004) find that students with a high level of striving and a low level of evaluative concerns tend to have a higher GPA compared with those with high levels of striving and evaluative concerns. Therefore, striving appears to enhance the acquisition of investment knowledge, whereas evaluative concerns tend to obstruct the acquisition of investment knowledge.

On the other hand, Van Rooij et al. (2012) ascertain that financial knowledge accelerates wealth accumulation through two channels. The first channel is stock market participation. A high level of financial knowledge reduces the cost of collecting and dealing with information and lower obstacles to investment in the stock market (Vissing-Jorgensen, 2003). Knowledgeable retail investors benefit from their equity premium. The second channel is retirement planning behaviour. Individuals with a high level of financial knowledge tend to plan for retirement and stick to their plans in terms of saving for their needs after retirement, collecting information, and carrying out their plans (Lusardi and Mitchell, 2011).

The third finding is that the absolute magnitude of the indirect effect of striving on liquid wealth is greater than that of evaluative concerns on liquid wealth when the other variables remain stable, thus providing evidence that the benefits of the adaptive facet of perfectionism can overpower the disadvantages derived from the maladaptive facet of perfectionism.

These findings identify one channel through which perfectionism can influence the accumulation of liquid wealth, thus bridging perfectionism and financial wellbeing.

3.6.3 Perfectionism, investment knowledge, liquid wealth, and financial risk tolerance

I now move forward to discuss the channels through which striving and evaluative concerns influence the level of financial risk tolerance. The relationship between striving and financial risk tolerance is complementarily mediated by investment knowledge. This relationship is also serially mediated by investment knowledge and in turn liquid wealth. The magnitude of the direct effect of striving on financial risk tolerance remains much larger than the magnitudes of indirect effects. Therefore, the first channel is investment knowledge, which involves the extent to which individuals have knowledge of financial markets, manage their own portfolios, and monitor market activities. The results indicate that striving (evaluative concerns) drives the increase (decrease) in investment knowledge, which in turn causes an increase (decrease) in liquid wealth. The finding of a relationship between investment knowledge and wealth accumulation is consistent with the findings of previous papers. Knowledge and cognitive capabilities are positively associated with the level of risk tolerance or negatively related to the degree of risk aversion (Benjamin et al., 2013; Dohmen et al., 2010), and in turn they influence financial decision-making through risk tolerance (Van Rooij et al., 2011). I contribute to the literature by linking perfectionism, investment knowledge, and risk tolerance because both cognitive abilities and risk preference are vital determining factors of a broad range of essential economic outcomes (Guiso and Paiella, 2005; Guiso and Paiella, 2008), whereas perfectionism is the psychological factor that links them.

The second channel through which perfectionism affects financial risk tolerance is knowledge followed by liquid wealth. In particular, I find that striving (evaluative concerns) is positively (negatively) associated with financial risk tolerance first through investment knowledge and subsequently through liquid wealth. In the previous section, I have discussed the reasons why perfectionism is associated with investment knowledge and liquid wealth. Therefore, I now proceed to discuss the reasons why the relationship between liquid wealth and financial risk tolerance exists. First, the empirical results are consistent with the findings from the previous literature. For example, Bucciol and Miniaci (2011) report that risk tolerance increases with wealth. Dohmen et al. (2011) present evidence that wealthier individuals are more likely to take

risks. Guiso and Paiella (2008) demonstrate that risk tolerance is a function of wealth. Based on these studies, risk tolerance can be influenced by the prospect of liquid constraints (Gollier, 2000) and by the existence of extra unpredictable, non-diversifiable risks (Eekhoudt et al., 1996).

I also find that the direct effect of striving on financial risk tolerance is positively significant and that its magnitude remains much greater than the magnitudes of both the mediation effect and the sequential mediation effect as well as their sum. A two-system decision process may be used to interpret the relationship between adaptive perfectionism and risk tolerance. This system proposes that decision-making reflects the interaction of a deliberative system and an emotional system (Bernheim and Rangle, 2004; Brocas and Carrillo, 2008). As the emotional system is assumed to be risk averse and short-sighted, adaptive perfectionism, as a type of personality type, is more likely to predict increased risk tolerance. The finding is consistent with the hypothesis derived from this two-system theory. It complements behavioral finance theory by enhancing the link between positive perfectionism and financial risk tolerance, which is valuable for understanding how individual heterogeneities in risk tolerances cumulatively generate whole market outcomes and provide implications for designing specific policies to alleviate this effect.

Finally, I do not find that evaluative concerns are directly associated with financial risk tolerance. However, an indirect effect exists, which I discussed above.

3.6.4 Perfectionism and gambling behaviours

Perfectionistic concerns are a significant factor in predicting monthly gambling expenditures. Those who exhibit intense concerns about mistakes tend to spend less money on gambling than those with low concerns about errors. This finding is consistent with the conclusion of Brand and Altstötter-Gleich (2008), who report that participants with perfectionistic concerns tend to select safe choices in behaviour experiments under risk conditions. This result implies that future research examining the relationship between personality traits and behaviours related to gambling need to incorporate perfectionism in a list of personality measures (Mishra et al., 2010).

3.6.5 Theoretical implications

This research advances the present understanding of perfectionism by theoretically developing and empirically examining the role of perfectionism in financial choices, thus providing a systematic picture outlining specific financial outcomes under risk (e.g., gambling) and the channels through which they occur. The most impressive finding is that adaptive perfectionism

predicts financial tolerance to risk. Therefore, in addition to the Big Five personality traits (Josef et al., 2016), I extend knowledge of the ability of perfectionistic striving to predict differences in risk-taking propensities by offering a theoretical justification and providing empirical evidence of processing via the channel of investment knowledge. I make a theoretical contribution by reporting the inhibitory function of perfectionistic concerns on gambling behaviour and by arguing that perfectionistic concerns do not always lead to negative life outcomes and can be less dysfunctional than reported in previous research. Finally, the present paper provides a general contribution to the literature by indicating that perfectionism can exert an influence on attitudes and behaviours in the finance domain.

3.7 Conclusion

The goal of this paper was to examine whether and how perfectionism predicts the variance of risk tolerance and gambling behaviours. I used an online survey sample with 661 US residents based on simple random sampling. Perfectionism is a multidimensional-personality trait that yields an interpretation of individual differences in attitudes and performance (Sherry et al., 2016). Perfectionistic striving captures positive characteristics, such as endurance, performance, achievement and positive affect, whereas perfectionistic concerns yield negative characteristics, such as fear of failure, low self-esteem and low self-efficacy.

The main finding is that financial risk tolerance increases with the level of perfectionistic striving, whereas the results do not indicate that evaluative concerns are directly associated with financial risk tolerance. Second, striving (evaluative concerns) is associated with increased (decreased) investment knowledge, which is in turn associated with increased (decreased) liquid wealth. Third, the magnitude of the indirect effect of striving on liquid wealth is greater than the magnitude of evaluative concerns on liquid wealth. Consequently, I report two channels through which perfectionistic striving influences financial risk tolerance. The first channel is investment knowledge, while the second channel is investment knowledge followed by liquid wealth. However, the direct effect of striving on risk tolerance remains and is larger than those indirect effects. Furthermore, perfectionistic concerns are negatively associated with financial risk tolerance only through investment knowledge, and through investment knowledge followed by liquid wealth. I do not detect any direct relationship between evaluative concerns and risk tolerance. Finally, the results indicate that perfectionistic concerns inhibit monthly gambling expenditures. This finding is consistently solid when I measure monthly gambling in both absolute form and relative form. These findings withstand robustness checks. By reporting these relationships, this preliminary study provides some important implications for theoretical and empirical research in behavioural finance. It also has practical implications

for financial well-being and life satisfaction. First, it strengthens the point that perfectionism has both active and negative facets that can have positive and adverse outcomes, respectively, such as increased and decreased wealth accumulation, or increased and reduced risk tolerance. Second, with respect to empirical implications, it may be of value to take into account the relationships between perfectionism and wealth accumulation when investigating the associations between perfectionism and other explanatory variables. With respect to policy implications, these findings may aid the development of deliberate interventions to support individuals who report poor financial well-being, poor life satisfaction, and a high level of negative affect. These interventions might include professional financial courses, adaptive perfectionism-oriented psychological counseling, and education, which can not only upgrade investment knowledge but also foster internalized standards for achievement and shrink the propensity to be afraid of mistakes and evaluation by others.

This study has some limitations. First, because of its pilot nature, this paper reports only one channel (investment knowledge) through which perfectionism influences wealth accumulation, and it reveals two channels (investment knowledge, and investment knowledge followed by liquid wealth) through which perfectionism predicts financial risk tolerance. Second, this paper does not explain the reasons why striving motivates an increase in risk tolerance whereas evaluative concerns do not. Third, these findings are based on a single-country sample and a cross-sectional analysis, which may limit the generalisability of the analysis results to other countries and cannot demonstrate causal inferences.

Future research can consider improving upon this research in the following ways. First, it would be valuable to explore additional channels through which perfectionism influences risk tolerance. Second, it may also be productive to use a more demographically diverse sample and conduct a cross-country analysis, to verify the applicability of the findings in different countries. Third, a longitudinal analysis is warranted to substantiate relationships. Finally, it may be profitable to investigate the effect of perfectionism on the heterogeneity of other preferences, such as time discounting and uncertainty aversion.

Chapter 4 Chronotype, risk and time preferences, and financial behaviours

Abstract

This paper examines the effect of chronotype on the delinquent credit card payments and stock market participation through preference channels. Using an online survey of 455 individuals who have been working for 3 to 8 years in companies in mainland China, the results reveal that morningness is negatively associated with delinquent credit card payments. Morningness also indirectly predicts delinquent credit card payments through time preference, but this relationship only exists when individuals` monthly income is at low and average level. On the other hand, financial risk preference accounts for the effect of morningness on stock market participation. Consequently, an additional finding is that morningness is positively associated with financial risk preference, which contradicts previous finding in the literature. Finally, based on the empirical evidence, I discuss the plausible mechanisms that may drive these relationships and the implications for theory and practice. The current study contributes to the literature by examining the links between circadian typology and particular financial behaviours of experienced workers.

4.1 Introduction

Circadian rhythm is a time-based oscillation in physiological and biological functions that reflect a cycle of approximately 24 hours. For humans and animals, the inner biological clock, which is situated in the suprachiasmatic nuclei of the hypothalamus, regulates this rhythm (Piffer et al., 2014). Sequentially, the hypothalamus secretess melatonin (Nelson, 2011). There is board individual heterogeneity in circadian rhythms, which can be identified by biological markers, such as sleep-wake patterns (Andretic et al., 2008), body temperature (Baehr et al., 2000; Kerkhof and Van Dongen, 1996), and genes (Franken and Dijk, 2009). The sleep-wake cycle can be measured as circadian chronotypes, also known as morningness-eveningness, which are distributed normally on a continuum (Natale and Cicogna, 2002), allowing the categorization of individuals into three groups: morning chronotype, neither type, and evening chronotype. Morning chronotype individuals, also known as "larks", are more likely to wake up in the early morning and to go asleep in the early evening as well. Evening chronotype individuals, also known as "owls", prefer to go to sleep late in the evening and to wake up later in the day (Horne and Ostberg, 1976).

For the last two decades, there has been increasing interest research into the effect of morningness-eveningness on multiple facets of life. Studies have reported links between the circadian chronotypes and work shifts (McLaughlin et al., 2008), jet lag (Waterhouse et al., 2002; Flower et al., 2003), cognitive efficiency (Colquhoun, 1971), cognitive style (Sternberg and Zhang, 2014), personality traits (Antúnez et al., 2014), academic performance (Piffer et al., 2014), mental disorders (Martin et al., 2012; Levandovski et al., 2011), and life habits (Achilles and Georgianna, 2003). Based on these findings, I notes that the circadian typologies influence psychological perspectives and behaviours, but mainly in the aspects of work, education, health. Very few researchers have examined the association between morningness-eveningness and financial behaviours. The effect of the circadian rhythm on financial well-being is important because financial well-being contributes positively to general life satisfaction (Kruger, 2011).

The first goal of this study is to investigate whether the circadian typology influence financial behaviours, especially delinquent credit card payments and stock market participation. First, revolving credit borrowers who do not entirely pay off their loans after the monthly deadline or miss payments have a larger amount of credit debt, compared to those who pay off such loan on time. From a financial perspective, delinquent credit card payments are not of benefit to long-term financial health because adopting the habit of making loan payment late leads to accumulated outstanding debt (Kim and DeVaney, 2001). Such consumers are more likely to have incomplete credit card debts, which in the short run leads to higher interest rates, financial

penalties, and higher outstanding balances (Elliehausen et al., 2007). Investigating the effect of morningness-eveningness on delinquent credit card payments could provide practical implications, such as interventions that prevent this behaviour or that help break the habit of not paying back loans according to monthly time schedule. Second, participation in the stock market is essentially a financial decision (Almenberg and Dreber, 2015), and it might be financially harmful if one refuses to take part in the stock market over the long term. The reason is that equity premium can provide long-term benefits for personal savings, which in turn influence personal financial well-being.

The second goal of the present study is to investigate the possible mechanisms through which morningness-eveningness influences delinquent credit card payments and stock market participation. I draw on the theories of risk preference and time preference, in order to provide a richer explanation regarding the likely channels. The first reason is that morning-types are positively associated with future time preference (Díaz-Morales et al., 2008; Stolarski et al., 2013), while Meier and Sprenger (2010) reported that present-biased individuals tend to have higher revolving credit balances compared with future-oriented individuals. Hence, the time perspective appears to be a possible channel between the circadian typology and incomplete monthly credit debt payments. The second reason is that morning larks are negatively associated with risk attitudes (Wang and Chartrand, 2015), while risk preference is a predictor of the probability of participating in stock market (Dohmen et al., 2011). Therefore, I anticipate risk preference would be a possible channel between chronotypes and owning equity. In addition, income may moderate the indirect effects of the circadian typologies on the likelihood of delinquent credit card payments and investments in stock because income is a determinant of outstanding balances among credit card revolvers (Calem and Mester, 1995; Kim and DeVaney, 2001) and is associated with risk preference (Tanaka et al., 2010).

I launched an online survey and received 455 valid questionnaires from employees who have 3 to 8 years of working experience. I used the Composite Scale of Morningness (CSM) (Smith et al., 1989) to measure the circadian chronotypes, measured the time perspective by following Finke and Huston (2013), and drew on a single question to measure financial risk preference, as proposed by Dohmen et al. (2011). I used regression and path analysis to examine the hypothesized relationships and the results revealed significant findings. First, the results indicate that morningness inhibits the likelihood of conducting late payments or missing payments on credit card debt. Second, time preference partially mediates the relationship between the morning chronotype and delinquent credit card payment, but this indirect effect only exists when subjects' income level is at average and low levels, for the path from time preference to incomplete credit card payment. The present study is of help to put forward the

underlying mechanism and the conditions of the association between the circadian typology and delinquent credit card payment. Furthermore, another novel finding is that financial risk preference fully mediates the link between morningness and the probability of owning equity. Hence, the current study helps to elucidate the unique channel and mechanism through which morning type exert influence on stock market participation. Furthermore, as those characteristics have been found in experienced workers, the results could be a valuable tool for financial professionals who should consider circadian rhythms when developing and introducing financial products or financial services for the morning-type, intermediate-type, and evening-type population. Future research could enhance the study of the relationship between morningness-eveningness, preference constructs, and financial behaviours by using a wider population, such as adding an aging group, sampling from different countries. In addition, longitudinal studies would be particularly powerful for testing the proposed relationships.

I organize the present paper as follows: In Section 4.2, I given a literature review to build up the hypothesized frameworks to examine the relationship between circadian chronotypes, risk and time preference, and financial behaviours. In Section 4.3, I describe sampling method, measurements of data, descriptive statistics of data, and econometric models. In Section 4.4, I reports the results. Section 4.5 is discussion, which provides theoretical and practical implications as well as some limitations of my research. I conclude in Section 4.6.

4.2 Literature review

4.2.1 Overview of theoretical rationale

In the context of personality psychology, circadian rhythm vary among individuals who can be classified as morning-types, neither-types, and evening-types. In particular, morning larks wake up in the early morning, achieve their peak performance physically and mentally in the early morning, and go to bed early in the evening. In contrast to morning larks, evening owls prefer to wake up late in the morning and go to bed late in the evening, and their peak performance is later in the day or in the evening (Cavallera and Giudici, 2008; Adan et al., 2012).
Researchers usually elicit circadian chronotypes by using self-reported survey questions (Randler, 2009). The first and most commonly used measure is the Morningness-eveningness questionnaire (MEQ) proposed by Horne and Ostberg (1976). Nevertheless, MEQ has been criticized due to its length (19 items) (Torsvall and Akerstedt, 1980). Its value arranges from 20 to 75. Smith et al. (1989) developed a short composite scale with 13 items (CSM). The authors classified the values on their morningness-eveningness scale into three groups using the cut-off points, with morning types (40 and above), intermediate types (23-43), and evening

types (22 or fewer). I will use the CSM scale for the Chinese population to measure circadian chronotypes and to validate the Chinese version of CSM.

The determinants of circadian typologies are various, including demographics, environmental, and biological and genetic factors (Cavallera and Giudici, 2008; Adan et al., 2012). First, age is a demographic factor that is positively associated with a morning orientation after the end of adolescence (Kim et al., 2010; Merikanto et al., 2012). Gender is another demographic factor; males are more likely to be evening owls, while females appear to be more morning-oriented (Adan and Natale, 2002). Second, the photoperiod at birth is an environmental factor that influences circadian chronotypes. Individuals who were born in autumn and winter are prone to be morning-types, whereas those born between spring and autumn are more likely to be evening owls (Mongrain et al., 2006). Another environmental factor is the longitude and latitude of residence. People who live in the East and North are more likely to be morning larks (Natale and Di Milia, 2011). Third, the biological expression of individual differences in circadian rhythms reflects that the acrophase of melatonin for morning larks occurs in the early morning, compared to evening owls (Duffy et al., 1999). Genetic factors also explain the variance in individual circadian rhythms, as a single nucleotide polymorphism positioned at the 3' flanking area of humans' CLOCK gene can be an interpreter of morning orientation for ordinal grownups (Katzenberg et al., 1998).

Circadian typology has been documented as a key individual characteristic in life, which influences cognitive performance. Prior research reported that the cognitive performance of morning-types is lower than that of evening-types (Roberts and Kyllonen, 1999). However, evening owls are better at intermediate memory (Natale and Lorenzetti, 1997). Circadian typology is also associated with psychiatric disorders, personality traits (Cavallera and Giudici, 2008; Antúnez et al., 2014), work shifts (Di Milia and Muller, 2012), and life habits (Tankova et al., 1994; Achilles and Georgianna, 2003). Therefore, previous studies have explored the effects of circadian rhythms on behaviours in the contexts of education, work, and health. However, to the best of my knowledge, very few studies have examined the effect of circadian rhythms on financial behaviours, such as revolving credit balance and stock market participation.

A credit card is a tool for convenient payment (Garman and Forgue, 2011). Credit card holder who do not pay off the entire loan before the monthly deadline or who miss the payments have higher amounts of credit card debt compared with those who pay off in time. Kim and DeVaney (2001) highlighted that poor loan payment habits drive the accumulation of outstanding debt. Hence, consumers who have such habits are more likely to have delinquent credit card payment, which in the short-run leads to higher interest rates, financial penalties, and higher outstanding balances (Elliehausen et al., 2007), and in the long-run harms consumers' financial well-being. If circadian rhythms can predict the possibility of having delinquent credit card debt, a better

understanding of this characteristic may help to improve borrowing behaviour and creditworthiness, which in turn contribute to a better financial situation. For example, if evening-types are positively associated with the possibility of having a revolving credit balance, shifting into morning circadian rhythm could be a helpful intervention, as morning larks are more conscientious and proactive about achieving long-term goals.

Stock market participation is an important financial decision (Almenberg and Dreber, 2015). It can be costly for individuals who do not invest in stocks because the stock premium can be a key predictor of the long-term benefits for personal savings, which in turn determine the status of personal financial well-being. Prior research has proposed a number of external and internal factors, which predict the likelihood to invest in stock, such as social interaction (Hong et al., 2004), awareness (Guiso and Jappelli, 2005), financial literacy (Van Rooij et al., 2011), IQ (Grinblatt et al., 2011), health (Rosen and Wu, 2004; Bogan and Fertig, 2013), gender (Almenberg and Dreber, 2015), and access to Internet (Bogan, 2008). Given the evidence that circadian rhythm are driven by biological and genetic factors and that they remain stable over time (Piffer et al., 2014), I examine whether morningness-eveningness influences the willingness to participate in the stock market.

Since these behaviours are financially meaningful, investigating the effect of circadian rhythms on these financial behaviours is my research goal.

4.2.2 Conceptual model and hypotheses development

Morning larks and delinquent credit card payments (H1)

The first goal of the present paper is to explore the relationship between morning-types and revolving credit card debt. In the literature, Randler (2009) reported that morning larks are prone to be more proactive than evening owls, which provides an inspiring starting point. In particular, proactivity is the willingness and capability to alter a situation to make it in one`s favour (Kirby and Kirby, 2006), and it can be influential in a wide range of circumstances. For example, a proactive personality connects to job autonomy through self-efficacy (Parker et al., 2006); proactive individuals attain more success in careers, earnings (Seibert et al., 1999), and studying performance (Kirby et al., 2002)

Although, few studies have examined the role of the circadian chronotypes in revolving credit card debt, by integrating the role of proactivity, it is reasonable to anticipate the negative association. On the one hand, morning-types are more proactive than evening-types, and on the other hand, proactivity describes the extent of which individuals anticipate, and minimize the negative influence of possible future problems, avoiding them completely if possible (Aspinwall et al., 2002; Aspinwall et al., 2005). At the same time, unpaid balances on credit cards represents such a negative potential problem that will increase consumers` interest rates

if they do not pay off their monthly balances on time (Hazembuller et al., 2007). Therefore, I expect that morning larks are much less likely to be unable to pay off their monthly credit card balance entirely. Accordingly, I propose:

Hypothesis 1: Morning-types are negatively associated with delinquent credit card payments. Specifically, compared to intermediate- and evening-types, morning larks are less likely to have unpaid credit card debt.

The mediating role of time preferences (H2)

To provide a richer explanation for morning chronotype's influence on delinquent credit card payments, I use theories of time perspective (i.e., future-oriented or present-biased). An individual's conception of time helps them to organize each life event in a methodical and anticipated rhythm (Milfont and Schwarzenthal, 2014). According to the neurological explanation, decisions that are expected to result in a future award in the region of the rational prefrontal cortex, whereas decisions that are expected to result in a present award occur in the emotional limbic region in the brain (Benedetti et al., 2007). Present-oriented individuals appear to seek immediate gratification at the cost of future utility. In contrast, future-oriented individuals are more likely to delay gratification in order to achieve long-run goals (Fudenburg and Levine, 2006).

Prior studies have reported a relationship between circadian rhythms and time perspectives. In particular, morning-types are positively associated with future time preference (Díaz-Morales and Sánchez-Lopez, 2008; Stolarski et al., 2013; Milfont and Schwarzenthal, 2014) and the processing channel is self-control (Milfont and Schwarzenthal, 2014), as more self-control results in reasonable decisions to delay gratification and to concentrate on achieving future goals. On the other hand, previous research has also suggested a link between time preference and credit card debt. Meier and Sprenger (2010) reported that present-discounting individuals have higher amount of revolving credit balances, compared with future-oriented individuals. Their results are also robust when changing the method of calculating the time perspective and the sample selection criteria. Therefore, to examine whether time discounting explains the association between morning-types and delinquent credit card payments, I propose:

Hypothesis 2: Time preference mediate the relationship between morning-types and delinquent credit card payments.

The moderating role of monthly income in a second-stage moderated mediation model (H3 and H4)

I have proposed that morningness influences the likelihood of delinquent credit card payment through time discounting, and I anticipate the strength of this mediating effect to vary according to the level of income in the path from time preference to delinquent credit card payments.

The life-cycle model assumes that consumers will maximize the utility from lifetime consumption (Ando and Modigliani, 1963), and Bryant (1990) proposed that borrowing is intended to change future resources into present resources with the purpose of increasing present consumption. Income is one determinant of outstanding credit card balances (Calem and Mester, 1995; Kim and DeVaney, 2001). These researchers reported that income is positively associated with the amount of outstanding credit card debt because the purpose of borrowing is to satisfy individuals' consumption demand throughout their lifetime. Therefore, in contrast to high income individuals, low and average income individuals are less likely to hold revolving credit card debt because they may be worried about the amount of such debt, which will add to their financial burden due to compounding interest rates (Kim and DeVaney, 2001). In addition, low- and average-income people would care about their personal credit over the long term. Therefore, to maintain a good level of personal credit (i.e., changeable utility from future resources into present resources), future-oriented individuals whose income is at low and average levels, are less likely to have delinquent credit card payments compared with their counterparts. Accordingly, I predict that income moderates the relationship between time perspectives and the probability of delinquent credit card debt and in turn moderates the indirect effect of morning orientation on delinquent credit card payments through the time perspective:

Hypothesis 3: Income moderates the relationship between time preference and delinquent credit card payments.

Hypothesis 4: The indirect effect of morning-types on delinquent credit card payments through the time perspective, is moderated by income, such that the indirect effect exists for those whose income is at low and average levels.

Morning larks and owning equity (H5)

The second goal of the present paper is to investigate the relationship between morning-types and the likelihood of owning hold stock. Prior studies have documented the determinants of stock market participation. They include wealth (Vissing-Jorgensen, 2002), education (Bayer et al., 2009), background income risk (Guiso et al., 1996; Heaton and Lucas, 2000), physical health (Rosen and Wu, 2004), mental health (Bogan and Fertig, 2013), financial literacy (Van Rooij et al., 2011), trust (Guiso et al., 2008), and cultural and social interactions (Grinblatt and Keloharju, 2001; Hong et al., 2004). More recently, Rao et al. (2016) reported that happiness is positively associated with investments in stock, whereas Biss and Hasher (2012) reported that

both younger and older people who are morning larks have higher levels of happiness. Therefore, I propose as follows:

Hypothesis 5: Morning-types are positively associated with investments in stock. In particular, compared with intermediate- and evening-types, morning larks are more likely to participate in the stock market.

The mediating role of financial risk preference (H6)

To provide a richer explanation of why morningness influences investments in stock, I use theories of financial risk preferences. On the one hand, previous research reported that morning larks are less likely to engage in financial risk behaviours and are negatively associated with risk attitudes (Wang and Chartrand, 2015). These researchers argued that self-control is the underling mechanism, as self-control is able to inhabit impulsivity, which contributes to risky behaviours. Morningness-types tend to be less impulsive. Guven and Hoxha (2015) supported this argument as well. Accordingly, it is reasonable to expect that morning larks have a lower level of financial risk preference compared with evening owls. On the other hand, another stream of literature advocated the opposite, such that happiness is positively associated with risk attitude. Anderson and Galinsky (2006) documented that optimism increases individuals' risk preferences, as optimistic people' cognitive appraisals engender high certainty and a higher probability of positive outcomes. Depressed-mood people are more risk averse compared with neutral and positive-mood individuals (Yuen and Lee, 2003). Although the prior literature has provided contradictory arguments regarding the relationship between positive moods and risk preference, given the evidence in the literature about the association between the morning chronotype and risk attitude, and that risk preference as a predictor of participation in the stock market (Dohmen et al., 2011), I propose the following hypothesis:

Hypothesis 6: Financial risk preference mediates the relationship between morning-types and stock market participation.

The moderating role of monthly income in a first-stage moderated mediation model (H7 and H8)

I have proposed that morningness influences the likelihood of investment in stock through financial risk preference, and I anticipate the strength of this mediating effect to vary according the level of income in the path from morningness to financial risk preference. Income is a determinant of individuals' general risk attitude, and financial risk attitude (Dohmen et al., 2011). These researchers reported that wealthier people are more willing to take risk. Tanaka et al. (2010) also argued that income is associated with risk preference. Therefore, the effect of

morningness on financial risk preference is stronger in the group of people who have average- and high-income levels. Accordingly, I propose as follows:

Hypothesis 7: Income moderates the relationship between morning-types and financial risk preference.

Hypothesis 8: The indirect effect of morning-types on investments in stock through financial risk preference is moderated by income, such that an indirect effect exist for those whose income is at average and high levels.

To summarize, I illustrate the conceptual models in Figure 4.1 and Figure 4.2

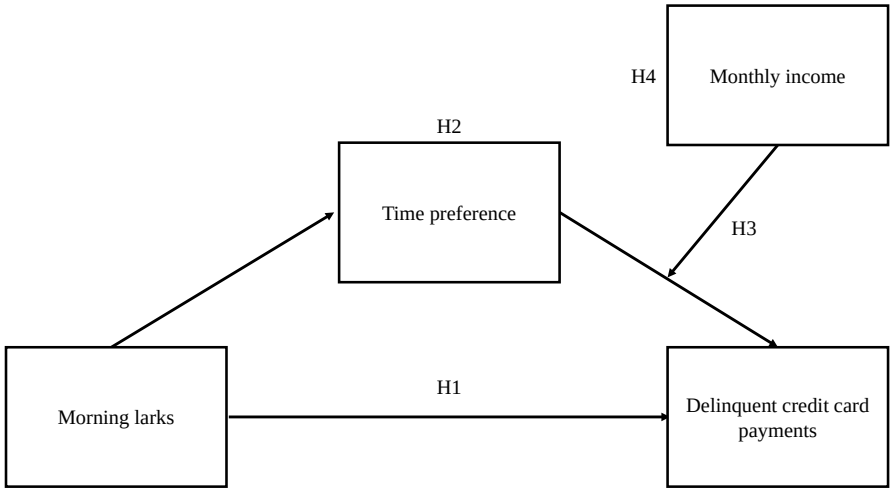


Figure 4.1 illustrates the conceptual model for the relationships among morning-types, time preference, and delinquent credit card payments. The direction of the arrows indicates the hypothesized effect.

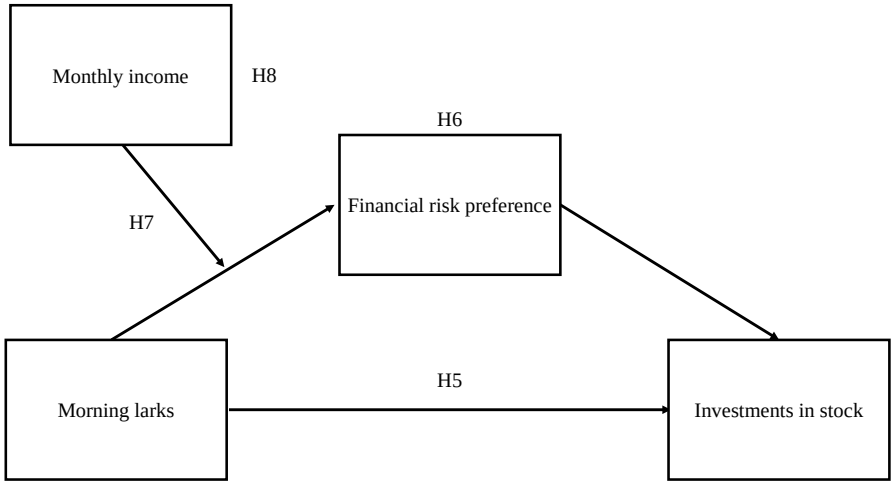


Figure 4.2 illustrates the conceptual model for the relationships among morning-types, financial risk preference, and investments in stock. The direction of the arrows indicates the hypothesized effect.

4.3 Methods

4.3.1 Sampling and data validation

I gathered the data by using an Internet-mediated survey, which was considered the only financially affordable choice because the target population (experienced labour force in China) is large and geographically scattered (Edwards et al., 2009). This survey comprises four parts. The first part was a participation information sheet that describe the academic purpose and objective of this research, gave the consent choice to potential respondents, and clarified that the data would remain confidential. The second part included a number of questions regarding circadian rhythms. The third and fourth parts asked for demographic information, individual in risk and time preferences and specific financial behaviours (i.e., holding stock and having revolving credit card debt).

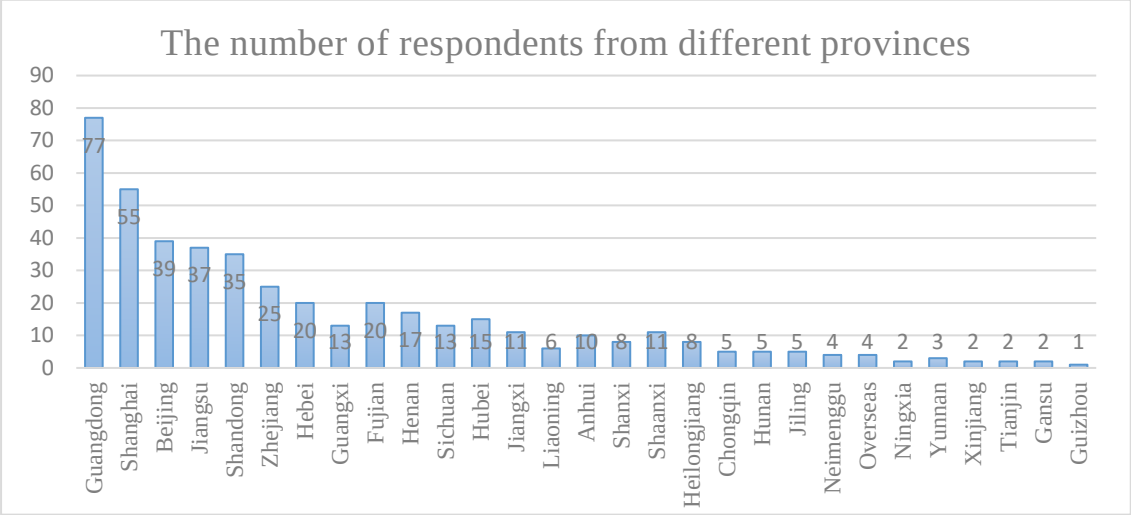
The present study distributed an online survey on Wjx (http://www.wjx.com) (previously called Sojump), which is a well-known online panel service provider in China. Online panel data collection is different from traditional online data collection because it collects data from registered online panel registers who agree to respond questionnaires for monetary compensation (Johnson, 2016). Wjx has a large survey-oriented sample pool (more than 2.6 million) in different cities in Mainland China that possesses diverse demographic features. In particular, Wjx selectively invites volunteers and individuals in their registered sampling pool to fill out an online survey, based on its customers' sampling frame. After validation, each respondent is given a monetary award. Hence, my sample should be deemed as a convenient sample (Hays et al., 2015). The survey was initially drafted in English and was subsequently translated to Chinese by the author that is natively speaking Chinese. Afterwards, another native Chinese speaker checked the consistency of the Chinese version survey (Chen et al., 2016). The Ethics and Research Governance group at the author's institution approved this study.

Totally, Wjx distributed the survey to 4472 panelists who fit the eligibility criteria in their panel, and 582 full-time employees in China with 3 to 8 years of working experience completed the survey. Because I enabled a force response setting in the survey, there are no missing values. I also enabled a time baseline; thus, 56 questionnaires that were submitted in less than the time baseline were automatically dropped. I further deleted 71 questionnaires because these respondents did not use credit cards, which is one of the interests of the present study, ultimately resulting in 455 valid questionnaires. Figure 4.3 is a bar chart that displays the number of respondents from different provinces. Figure 4.4 illustrates the distribution of respondents on a flat map of China generated in Excel 2016 and provides the population density of China in 2010 (Liu et al., 2015), in order to detecting whether my sample achieved adequate geographical

disperse and representativeness. In general, my online sample roughly fits the geographical distribution of the general population.

In addition, I draw the reader's attention to the four observations from overseas. I do not deny the possibility that these respondents had travelled to or temporarily visited overseas countries when they submitted the questionnaires.

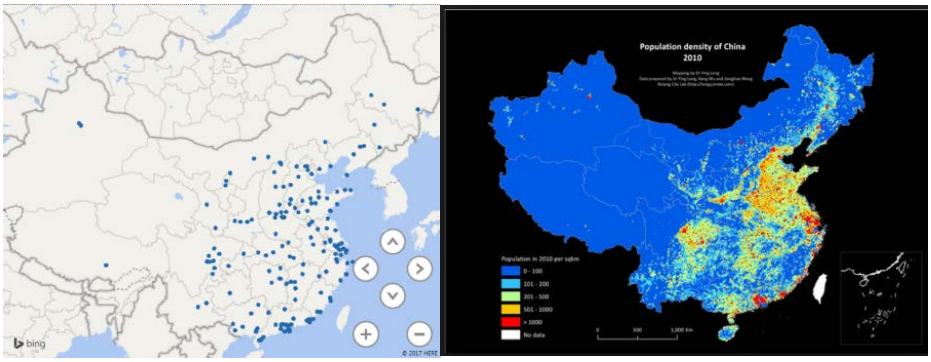
Figure 4.3 reports the number of respondents from different provinces in China.



Note: This bar chart displays the number of observations by provinces. The x-axis lists the names of the provinces, while the y-axis lists the number of respondents from each province.

Internet-mediated surveys have the advantages of being a cheaper and faster way to collect data and reducing social desirability bias (Burkill et al., 2016; Kreuter et al., 2008). However, Couper (2017) reported that there are challenges for inferential studies using this mode for surveys, such as non-response bias (i.e., low response rate) and coverage bias (i.e., offline population concerns (Callegaro and DiSogra, 2008). The response rate is broadly deemed to be an important sign of data quality (Biemer and Lyberg, 2003). Accordingly, in this paper, the response rate was 13.01% (582/4472), which is low and quite similar to likely response rate 11% mentioned by Saunders et al. (2012; pp. 421). Therefore, it raised concern about data quality (Meterko et al., 2015; Couper, 2017).

Figure 4.4 depicts the locations of the sample participants who live in in China (left) and the population density of China in 2010.



Note: Each solid blue point represents the location of one respondent. From the perspective of geography, my samples is distributed randomly across the provinces of China. The diagram on the right displays the population density of China in 2010 (Liu et al., 2015).

Nevertheless, researchers should evaluate the merits of survey results and not depend solely on the response rate (Meterko et al., 2015), as a low response rate does not necessarily indicate non-response bias, although it raises suspicion. A study with a low response rate that examines relationships should not automatically be assumed to be problematic or less credible (Rindfuss et al., 2015). Potential non-response bias derived from a low response rate is less of a concern in a relationship-oriented analysis than in a distributional analysis and non-response bias can indicate discrepancies in survey items (Groves and Peytcheva, 2008; Smith, 2009; Rindfuss et al., 2015). In the literature, there is empirical evidence supporting that the contention that there is little difference in the results between low-response rate surveys and high-response-rate surveys, such as Smith (2009), Visser et al. (1996), Curtin et al. (2000), Keeter et al. (2006). More recently, Holbrook et al. (2007) stated that low-response survey diminished demographic representativeness, but not that much.

Other concerns with using an online panel survey are coverage bias and self-selection bias. To quantitatively examine these types of bias and determine how my sample may be different from the target population, it is helpful to compare my sample data with the census data regarding Internet penetration, education, age and gender. First, the Chinese population as of 2017 is 1.4 billion (Worldometers, 2017), of which there approximately 1 billion can access Internet (Statista, 2017). Therefore, Internet penetration in China now is approximately 71.4%. In other words, approximately 28.6% of the population are non-Internet user and are therefore mot covered in the sample. Hence, the results would be possibly biased, as the findings might only represent 71.4% of the entire population. In addition, regarding the education level of the labour force, the median educational attainment in my sample is the undergraduate level, which is higher than shown in census data, as only 36.5% of the general population have experienced tertiary education (World Development Indicator, 2016). This is a disadvantage of an Internet-mediated survey, which tends to generate a sample with higher educational attainment than the census data (Paz et al., 2013). Therefore, I remains cautious and acknowledge these limitations of using an online panel survey in this paper. Nevertheless, age, income and the gender ratio of my sample quite closely match the labour force population in China. First, the proportion of working females in my sample is 62%, and one study reported that 56.7% of the workforce in China are females (Community Business, 2014). Second, as of 2017, China's average per capita income was 8,480 US dollars (equivalent to 56,114 Yuan) (International Monetary Fund, 2017), which is quite close to the median category of monthly income in my sample of between 5,000 and 7,500 US dollars (equivalent to annual income 60,000 and 90,000 Yuan). Third, the average age of the labour force in China is 36 years old (China Human Capital Report, 2016), which is within the median group of my sample of between 30 and 44 years old.

4.3.2 Measures

Chronotype. The composite scale (Smith et al., 1989) (CSM) extracts 13 items from the Horne and Ostberg (1976) scale and the Torsvall and Akerstedt (1980) scale. It is widely used to measure morningness-eveningness and has multiple language versions, including French (Caci et al., 1999), Spanish (Adan et al., 2005), German (Randler, 2008c), and Thai (Pornpitakpan, 1998). Specifically, nine items from Hornes and Osberg (1976) have Chinese versions in the literature (Gau et al., 1998; Li et al., 2011); and thus, I directly used these items in the questionnaire. However, four items are from the Torsvall and Akerstedt (1980) scale (their items 1, 4, 6, and 7), which have not been translated into Chinese in the literature. Therefore, I invited a Chinese native speaker who is proficient in both English and Chinese to translate these four items in parallel to ensure the validity and conceptual correspondence for the Chinese circumstance. The CSM scale ranges from 13 (extreme evening owl) to 65 (extreme morning larks). Furthermore, I tested the reliability of this measure in the Chinese version using Cronbach's alpha (Cronbach, 1951). Hinton et al. (2014) proposed four interval-based categories to assess the reliability of a summative scale (Likert, 1932), which consist of excellent reliability (0.90 and above), high reliability (0.70-0.90), moderate reliability (0.50-0.70), and low reliability (0.50 and below). The Cronbach's alpha for the Chinese adaptation of the CSM was 0.879, indicating that it is highly reliable, and this value is very close to that of the original English version of the CSM (Smith et al., 1989; Cronbach`s alpha=0.87). Finally, I categorized the continuum of the CSM values into three chronotypes, following Smith et al., 1989). I have 60 observations of morning-types (44 and above), 384 observations of intermediate-types (23-43), and only six observations of evening-types (22 and less). Because of the very few observations of evening type, I re-categorized the sample to generate one binary variable, where one indicates morning-type while zero denotes non-morning-type.

Time preference. I use a combination of intertemporal behaviours to proxy time preference, as proposed by Finke and Huston (2013), who constructed a summative scale using eight items, each representing one behaviour, with outcomes at different time points. The reason is to choose this method is that Finke and Huston (2013) showed that this additive index is a strong predictor for measuring time discounting compared with traditional measurements in which respondents are asked to choose between receiving a small amount of money right now or a larger amount of money in the future. I also invited a native Chinese speaker who are proficient in both English and Chinese to translate these questions. Participants sequentially answered seven of eight questions about wearing a seatbelt when driving a car, smoking, drinking wine, using nutrition labels when shopping for food, engaging in arduous physical exercise, unprotected sex behaviours, and choosing food for the purpose of maintain diet. Nevertheless, the last question was dropped, which asked whether the respondent used drugs or any controlled substances.

Because both the recreational and medical use of marijuana or cannabis are banned and severely enforced throughout China (Bi, 2012), this questions was not appropriate. Respondents were asked to respond on a five-point Likert scale ranging from "never" to "always". For positive behaviours, such as wearing the seatbelt when driving a car, I coded 1 for those who never wear the seatbelt and 5 for those who always wear it. In contrast, for negative behaviours, such as consuming wine, I coded 1 for those drink wine almost every day and 5 for those who never consume alcoholic drinks. Hence, this additive scale ranges from 7 to 35, where higher scores represent individuals who emphasize future goal attainment and delay gratification. The Cronbach's alpha for this Chinese version time perspective scale was 0.573, indicating that it is moderately reliable.

Risk preference. I use one simple and behaviourally valid survey question to measure risk attitudes in a financial context, following Dohmen et al. (2011). Although economists question whether self-reported individual preference and traits are behaviourally meaningful due to incentive compatibility, Dohmen et al. (2011) reported that this measure maps onto actual monetary outcomes from lottery choice experiments (Holt and Laury, 2002; Eckel and Grossman, 2008), which in turn give us confidence using this survey question to elicit risk attitudes. This question directly asks respondent to make a general assessment regarding their willingness to take financial risk: "How willing are you to take risks, in financial matters?" Participants rate their financial risk attitude from 0 to 10. More importantly, this measure is empirically valid in explaining individual differences in financial decision, such as investments in stock, in a large representative survey. I also translated this question into Chinese, as I distributed this survey in Mainland China.

Financial behaviours. I aim to investigate whether and how the circadian typologies may influence individual's credit behaviour, such as delinquent credit card payments. I asked the respondents one simple question: "Please indicate below the option that best describes your payments on credit cards." Five exclusive options are available (Mandell and Klein, 2009; Fernandes et al., 2014), including "Always pays off monthly", "Generally pays off monthly", "Occasionally pays off monthly", "Seldom pays off, but tries to pay down", and "Generally pays minimum each month". I coded zero for respondents providing the answer "Always pays off monthly" and one for the other answers. I also examine whether and how circadian rhythms affect individuals' investment behaviour, such as willingness to participate in the stock market. I asked one simple question: "Have you ever invested in stock market?" Two options are provided. I scored one if respondents answer "Yes" and score zero if respondents answer "No". These questions were translated into Chinese when distributing the surveys to the respondents.

Control variables. To reduce omitted variable bias when estimating the effect of morningness-eveningness on the preference constructs and in turn financial behaviours (i.e. revolving credit card debt and investments in stock), I included demographic information in the survey.

Specifically, the survey included age, gender, marital status, education, and monthly income (Lawrance, 1991; Rosen et al., 2003; Eckel and Grossman, 2008; Borghans et al., 2009; Bucciol and Miniaci, 2011; Van Rooij et al., 2011; Meier and Sprenger, 2010; Dittrich and Leipold, 2014; Almenberg and Dreber, 2015). I measure age with a single question "What is your age?" Respondents were provided with three options, "18 to 29 years old", "30 to 44 years old", and "45 to 54 years old", which are marked from 1 to 3. Male is dichotomously measured, where one indicates male and zero otherwise. Marital status is also a binary variable, where one indicates married and zero otherwise. Educational attainment is an ordinal variable that ranges from one to six, denoting "Lower than high school", "High school", "College", "Bachelor's degree", "Master's degree", and "Doctoral degree", respectively. The measurement of monthly income is a single question: "What is your monthly income?" Respondents were provided with six options, consisting of "Less than 3000", "3000 to 5000", "5000 to 7500", "7500 to 10000", "10000 to 20000", and "More than 2000", which are marked from 1 to 6, respectively. The units are RMB. I translated these questions into Chinese when distributing the surveys. To summarize, these variables are possibly exogenous with respect to individual preferences and financial behaviours and can therefore, which is used to help interpreting links in the regression estimates.

To view the original questions for these measurements, please see Appendix C.

4.3.3 Data description

Table 4.1 reports descriptive statistics of the measured variables. The distribution of respondents in the circadian typology groups was 60 in the morning type (13.19%) and 395 in the non-morning-type (86.81%). The distribution of time preference scores (skewness=-0.522; Kurtosis=4.043) and financial risk preferences (skewness=-0.857; Kurtosis=3.636) were both left-skewed; thus, the results associated with these measures must be treated carefully. A total of 65.7% and 34.1% of the respondents invest in the stock market and have the credit card debt, respectively. In addition, I have a relatively gender-balanced sample (177 men and 278 women). The Pearson's correlation matrix of the variables is shown in Table 4.2. The correlation analysis supported the majority of the proposed hypotheses. As expected, morning larks are prone to being future-oriented ($r=0.262$, $p<0.01$) and are less likely to have unpaid credit card debt ($r=-0.157$, $p<0.01$). Second, morning-oriented people are more risk taking ($r=0.131$, $p<0.01$) and in turn are more likely to invest in the stock market ($r=0.303$, $p<0.01$).

Table 4.1 Descriptive statistics of the study's variables.

Variables	Observations	Mean	SE	Min	Max
Morningness	455	0.132	0.339	0	1

Age	455	1.378	0.485	1	2
Male	455	0.389	0.488	0	1
Married	455	0.752	0.432	0	1
Education	455	3.936	0.558	1	6
Monthly income	455	3.342	1.105	1	6
Time preference	455	25.164	2.959	13	32
Financial risk preference	455	7.569	1.926	1	11
Stock market participation	455	0.657	0.475	0	1
Delinquent credit card payments	455	0.341	0.474	0	1

To test the level of collinearity, I calculated the variance inflation factors for the variables, and they are all smaller than 2, suggesting that the level of collinearity is not problematic (Neter et al., 2004). To further examine the relationships between the key variables of interest, I use the independent group t-test to examine mean difference on concerned variables between morning-types and non-morning-types. Specifically, morning-types scored higher on time perspective (M=27.150; SD=0.345) than non-morning-types (M=24.863; SD=0.145), t(453)=5.771, p<0.001, difference=2.29) and had a higher level of financial risk taking (M=8.217; SD=0.257, vs. M=7.471; SD=0.096, t(453)=2.816, p<0.001, difference=0.746).

4.3.4 Econometrics model

To test the direct effect of morningness on delinquent credit card payments (Hypothesis 1) and on investments in stock (Hypothesis 5), I use a logistic regression model, since delinquent credit card payments and investments in stock are dichotomously-measured dependent variables. Additionally, logistic regression also has a number of advantages. First, neither the dependent nor the independent variables have to be normally distributed. Similarly, logistic regression does not assume that the error terms have to be in normal distribution. More importantly, it does not assume that the relationships between the independent and dependent variables are linear.

I specify the following logistic models to test relationship between morning-type and delinquent credit card payments (Hypothesis 1):

$(1)\ Delinquent\ credit\ card\ payment_i = \beta_0 + \beta_1 Morningness + \beta_2 Time\ preference + \sum_{k=5}^{K} \beta_k X_{ik} + \epsilon_i,$

where X_{ik} is the set of control variables of individual i, including age, male, marital status, education, and monthly income. ϵ_i is the error term.

Table 4.2 Pearson`s correlation coefficients for key study variables.

Variables	1	2	3	4	5	6	7	8	9
1.Morningness									
2.Age	0.058								
3.Male	-0.058	-0.036							
4. Married	0.014	0.291***	-0.105**						
5. Education	0.033	0.032	0.010	0.035					
6. Monthly income	0.067	0.152***	0.112**	0.183***	0.354***				
7. Time preference	0.262***	0.104**	-0.167***	0.020	0.188***	0.037			
8. Financial risk preference	0.131***	0.002	0.200***	0.088	0.042	0.240***	0.080		
9. Stock participation	0.104**	0.048	0.159***	0.110**	0.175***	0.187***	0.025	0.303***	
10. Delinquent credit card payments	-0.157***	0.004	0.016	0.038	-0.043	0.050	-0.156***	0.053	0.031

Note: N=455; * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

The model specification to examine the link between morning-type and stock ownership is as follows (Hypothesis 5):

$$(2)\ Owning\ stock_i = \beta_0 + \beta_1 Morningness + \beta_2 Finanical\ risk\ prefernce + \sum_{k=5}^{K} \beta_k X_{ik} + \epsilon_i,$$

where X_{ik} is a vector of control variables of individual i, including age, male, marital status, education, and monthly income. ϵ_i is the error term.

To test the moderating role of income on the link between time preference and delinquent credit card debt (Hypothesis 3), I use a logistic regression model with an interaction item ($Time\ preference \times Monthly\ income$), as delinquent credit card debt is a dichotomous variable. The model specification is:

$$(3)\ Delinquent\ credit\ card\ debt_i = \beta_0 + \beta_1 Time\ preferece + \beta_2 Time\ preference \times Monthly\ income + \beta_3 Monthly\ income + \sum_{k=4}^{K} \beta_k X_{ik} + \epsilon_i,$$

where X_{ik} is a vector of control variables of individual i, including age, male, marital status, and education. ϵ_i is the error term.

To test the moderating role of income on the link between morning type and financial risk preference (Hypothesis 7), I use an OLS regression model with an interaction item ($Morning\ type \times Monthly\ income$). The model specification is:

$$(4)\ Financial\ risk\ preference_i = \beta_0 + \beta_1 Morning\ type + \beta_2 Morning\ type \times Monthly\ income + \beta_3 Monthly\ income + \sum_{k=4}^{K} \beta_k X_{ik} + \epsilon_i,$$

where X_{ik} is a vector of control variables of individual i, including age, male, marital status, and education. ϵ_i is the error term.

Next, I used path analysis to test whether time perspective mediates the relationship between morning-type and delinquent credit card payments (Hypothesis 2) and whether financial risk attitude mediates the link between morning-type and investments in stock (Hypothesis 6). To test these mediation models, I used the PROCESS macro (Hayes, 2013) in SPSS 24.0 and conducted bootstrapping with 5,000 resampling to verify the statistical significance. Furthermore, I also used path analysis with in the PROCSS macro to investigate the moderating role of income on the indirect effect between morningness and delinquent credit card payments through time preference, on the path from time preference to delinquent credit card payments (Hypothesis 4). Similarly, I applied this method to examine whether income affects the indirect

effect of morningness on stock ownership through financial risk preference on path from morningness to financial risk preference (Hypothesis 8).

4.4 Results

4.4.1 Direct effect of morning chronotype on the likelihood of having revolving credit card debt (H1)

Table 4.3 reports the average marginal effect of morningness on delinquent credit card payments based on the logistic regression. The independent variable is morningness, indicating the morning type of circadian chronotypes. The results indicate that morning types are negatively associated with delinquent credit card payments. In other words, compared with the other chronotypes, the percentage of having delinquent credit card payments for morningness people is 19.4% lower. Although I control for age, male, marital status, education, monthly-income, and time preference, only time preference is significant in predicting the variance of delinquent credit card payment. In summary, results indicate that morning types attenuate revolving credit card payments, which are in support of hypothesis 1.

Table 4.3 reports the average marginal effect of morningness on delinquent credit card payment in logistic regression.

Dependent variable: Delinquent credit card payments	Logistic regression			
Variables	Average marginal effect	SE	z-statistic	p-value
Main variables				
Morningness	-0.194***	0.057	-3.41	0.001
Control variables				
Age	0.005	0.048	0.10	0.917
Male	-0.016	0.045	-0.37	0.712
Married	0.028	0.052	0.53	0.593
Education	-0.035	0.043	-0.82	0.412
Monthly_income	0.031	0.023	1.36	0.174
Time preference	-0.019**	0.008	-2.31	0.021
Log pseudolikelihood	-280.78662			
Pseudo R2	0.038			
Number of observations	455			

Note: The dependent variable is delinquent credit card payments. This table reports the average marginal effect of logistic regression regarding the effect of morningness on the delinquent credit card payments. The sample include China full-time employees who have been working for 3 to 8 years, randomly sampled using an online survey. *, **, and *** indicate significance at the 10% level (2-sided), 5% level, and 1% level, respectively. Pseudo R2 reports the model fit.

4.4.2 The mediating role of time perspective (H2)

First, I use OLS regression to investigate the relationship between morningness and time preference. Second, a logistic regression is performed to examine the relationship between time preference and delinquent credit card payments. Consequently, I am able to test whether time

preference mediates the link between morningness and delinquent credit card payments (Hypothesis 3). Table 4.4 reports the results of this mediation model. The results indicate that the morning chronotype is positively associated with time preference (path a: coefficient is 2.136, SE=0.375, t=5.701) and time preference is negatively associated with delinquent credit card payments (path b: coefficient is -0.087, SE=0.037, z=-2.367). Since a-path and b-path are both significant, which indicates that there is a mediation effect. To further test the significance of this mediation effect (indirect effect a*b), I use the bootstrapping method with bias-corrected confidence estimates (Preacher and Hayes, 2008). Subsequently, the 95% confidence interval of the indirect effect is taken with 5,000 bootstraps resamples (Preacher and Hayes, 2008). If the confidence interval of the estimator does not contain 0, it indicates that the indirect effect is significantly different from zero. The results of the bootstrap test show that time preference mediates the link between morningness and the delinquent credit card payments (indirect effect=a*b=-0.186, SE=0.092, 95% CI =from -0.391 to -0.030). Moreover, when adding time preference, the relationship between the morning chronotype and delinquent credit card payments is still significant (path c`: coefficient is -1.045, SE=0.386, Z=-2.704). This results means that time preference is a partial mediator. To summarize, the results are in support of hypothesis 2. In other words, I find that time preference is one channel through which morningness negatively influences the likelihood of delinquent credit card payments. Please see Figure 4.5.

Table 4.4 The mediating effect of time preference on the relationship between morningness and delinquent credit card payments.

	Time preference			Delinquent credit card payments		
Variables	Coefficient	SE	t	Coefficient	SE	z
Constant	20.912***	1.051	19.890	1.684	1.092	1.543
Morningness	2.136***	0.375	5.701	-1.045***	0.386	-2.704
Age	0.557**	0.273	2.039	0.023	0.221	0.106
Male	-0.904***	0.272	-3.324	-0.078	0.214	-0.365
Married	-0.169	0.337	-0.500	0.132	0.253	0.522
Education	1.029***	0.293	3.511	-0.164	0.196	-0.837
Monthly_income	-0.110	0.162	-0.682	0.145	0.102	1.415
Time preference				-0.087**	0.037	-2.367
R2	0.133					
Pseudo R2				0.038		
Number of observations	455			455		

Mediator	Bootstrapping effect	Boot SE	95% CI (LL, UL)	
Time preference				
Indirect effect	-0.186	0.092	-0.391	-0.030

Note: Unstandardized regression coefficients are reported; bootstrap sample size=5,000. CI=confidence interval; LL=lower limit; UL= upper limit. * indicates p<0.1, ** indicates p<.05, and *** indicates p<0.01.

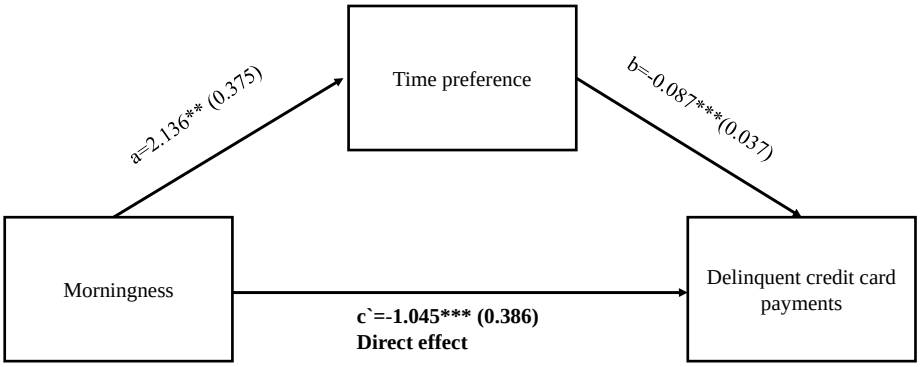


Figure 4.5: The indirect effect of morningness on delinquent credit card payments through time preference is statistically significant (a*b= -0.186, SE=0.092, 95% CI=[-0.391, -0.030]). Bootstrapped resample is 5,000. *p<0.10,**p<0.05, ***p<0.01.

4.4.3 The moderating role of income on the indirect effect of morningness on delinquent credit card payments (H3 and H4)

Table 4.5 summarizes the statistical results of the moderation model that investigates the moderating effect of monthly income on the relationship between time preference and delinquent credit card payments. The dependent variable is delinquent credit card payments. The independent variable is time preference, and the moderator is monthly income. I grand-mean-center the moderator (Monthly_income) and the independent variable (Time preference) according to the approach proposed by Aiken et al. (1991). In particular, after the effects of the control variables and the main effects of time preference are accounted, I find that the coefficient of the cross product between monthly income and time preference is 0.062, t=2.228, p=0.026, yielding a significant interaction effect in relation to delinquent credit card payments. The results support Hypothesis 3.

Table 4.5 The moderation effect of monthly income on the relationship between time preference and delinquent credit card payments.

Dependent variables: Delinquent credit card payments	Monthly income as a moderator in logistic regression			
Variables	Coefficients	SD	t-statistic	p-value
Constant	-0.047	0.866	-0.054	0.956
Age	0.084	0.223	0.376	0.707
Male	-0.088	0.215	-0.410	0.682
Married	0.096	0.255	0.376	0.707
Education	-0.174	0.197	-0.884	0.377
Morningness	-1.118***	0.392	-2.858	0.004
Monthly_income	0.191*	0.105	1.817	0.069
Time preference	-0.106***	0.038	-2.765	0.006
Monthly_income*Time preference	0.062**	0.028	2.228	0.026
Pseudo R2	0.047			
Number of observations	455			

Note: The dependent variable is delinquent credit card payments. Monthly_income is the moderator. This table reports the coefficients from the logistic regression examining the moderating effect of monthly income on the relationship between time preference and delinquent credit card payment. The sample includes residents of China

who have been working for 3 to 8 years, randomly sampled using an online survey. *, **, and *** indicate significant at 10% level (2-sided), 5% level, and 1% level, respectively.

Table 4.6 The conditional indirect effect of morningness on delinquent credit card payments.

	Time preference			Delinquent credit card payment		
Variables	Coefficient	SE	t	Coefficient	SE	z
Constant	-4.245***	1.053	-4.033	-0.047	0.866	-0.054
Age	0.532*	0.278	1.912	0.084	0.223	0.376
Male	-0.936***	0.274	-3.413	-0.088	0.215	-0.410
Married	-0.213	0.328	-0.649	0.096	0.255	0.376
Education	0.964***	0.262	3.643	-0.174	0.197	-0.884
Morningness	2.116***	0.368	5.745	-1.118***	0.392	-2.858
Monthly_income				0.191*	0.105	1.817
Time preference				-0.106***	0.038	-2.765
Monthly_income*Time preference				0.062**	0.028	2.228
R2	0.131					
Pseudo R2				0.047		
Number of observations	455			455		
Moderator: Monthly_income	Bootstrapping indirect effect		Boot SE		95% CI (LL, UL)	
Low (-1 SD from mean)	-0.368		0.138		-0.684	-0.143
Average (0 SD from mean)	-0.224		0.093		-0.431	-0.064
High (+1 SD from mean)	-0.079		0.097		-0.280	0.105
Index of moderated mediation						
Mediator	Index	Boot SE			95% CI (LL, UL)	
Time preference	0.131	0.067			0.013	0.277

Note: Unstandardized regression coefficients are reported; bootstrap sample size=5,000. CI=confidence interval; LL=lower limit; UL= upper limit. * indicates p<0.1, ** indicates p<.05, and *** indicates p<0.01.

To explore the indirect relationship between morningness and delinquent credit card payments through time preference would be conditional on the moderator variable of monthly income for the path from time preference to delinquent credit card payments, I use the bootstrap methods proposed by Hayes (2013) to test this hypothesized second-stage moderated mediation model (Hypothesis 4). The first step is to examine the interactive effect of time preference and monthly income on delinquent credit card payments. The results suggest that the interaction term between monthly income and time preference is significant (b=0.062, p<0.05). Table 4.6 displays the details. The second step is to investigate the conditional indirect effects at 1 standard deviation above (high monthly income), at 0 standard deviation from (average monthly income), and at 1 standard deviation below the mean of the moderator (low monthly income). Table 4.6 reports the details of the moderated mediation model test.

In particular, for low monthly income, the moderated mediation model is significant (indirect effect= -0.368, SE=0.138, 95% CI = [-0.684, -0.143]). Therefore, morning-type people with low monthly income have less likelihood of delinquent credit card payments by 0.368. Similarly, for average monthly income, the moderated mediation model is also significant (indirect effect=0.224, SE=0.093, 95% CI = [-0.431, -0.064]). Hence, morning-type people

with average monthly income have a propensity for decreasing the likelihood of delinquent credit card payment by 0.224. However, for high monthly income, the moderated mediation model is not significant (indirect effect=-0.079, SE=0.097, 95% CI = [-0.280, 0.105]). The index of moderated mediation (Hayes, 2015) quantifies this conditional indirect effect (b=0.131, SE=0.067, 95% CI= [0.013, 0.277]). Together, the results indicate that morningness is more likely to influence delinquent credit card payment behaviour through time preference when income is at low and average levels.

To summarize, there findings above indicate that the morning chronotype influences delinquent credit card payments through time preference, and that the indirect effects change according to different levels of monthly income.

Table 4.7 The effect of morningness on stock market participation based on logistic regression.

Dependent Variables: Stock market participation	Logistic regression			
Variables	Average marginal effect	SE	z-statistic	p-value
Main variables				
Morningness	0.099*	0.056	1.76	0.079
Control variables				
Age	0.011	0.044	0.24	0.812
Male	0.111**	0.045	2.49	0.013
Married	0.091*	0.051	1.77	0.076
Education	0.121***	0.037	3.24	0.001
Monthly_income	0.018	0.021	0.86	0.389
Financial risk preference	0.056**	0.011	5.24	0.001
Log pseudolikelihood	-258.340			
Pseudo R2	0.117			
Number of observation	455			

Note: The dependent variable is stock market participation. This table reports the average marginal effect based on logistic regression examining the effect of morningness on the stock market participation. The sample is China residents who have been working for 3 to 8 years, randomly sampled with the online survey. *, **, and *** indicate significance at 10% level (2-sided), 5% level, and 1% level, respectively.

4.4.4 The direct effect of morningness on the likelihood of investments in stock (H5)

Table 4.7 reports the average marginal effect of morningness on stock market participation using a logistic regression. The independent variable is morningness, indicating the morning type of circadian chronotypes. The results indicate that morning type is not positively associated with stock market participation (average marginal effect of morningness is 0.099, SE=0.056, z-statistics=1.76, p=0.079). In other words, comparing with other chronotypes, the percentage of owning stock for morningness people is not significant from zero. In summary, the results do not support Hypothesis 5.

4.4.5 The mediating role of financial risk preference (H6)

Table 4.8 The mediating effect of financial risk preference on the relationship between morningness and stock market participation.

	Financial risk preference			Stock market participation		
Variables	Coefficient	SE	t	Coefficient	SE	z
Constant	6.514***	0.654	9.953	-4.978***	0.962	-5.175
Morningness	0.745***	0.277	2.688	0.543	0.351	1.551
Age	-0.225	0.189	-1.192	0.055	0.234	0.233
Male	0.750***	0.179	4.186	0.577**	0.234	2.471
Married	0.375	0.232	1.619	0.455*	0.258	1.768
Education	-0.147	0.164	-0.895	0.629***	0.212	2.976
Monthly_income	0.381***	0.093	4.080	0.095	0.109	0.869
Financial risk preference				0.293***	0.059	4.934
R2	0.113					
Pseudo R2				0.117		
Number of observations	455			455		
Mediator	Bootstrapping		Boot SE		95% CI (LL, UL)	
Financial preference	effect					
Indirect effect	0.219		0.096		0.054	0.425

Note: Unstandardized regression coefficients are reported; bootstrap sample size=5,000. CI=confidence interval; LL=lower limit; UL= upper limit. * indicates p<0.1, ** indicates p<.05, and *** indicates p<0.01.

First, an OLS regression is used to investigate the relationship between morningness and financial risk preference. Second, a logistic regression is conducted to examine the relationship between financial risk preference and stock market participation. Consequently, I am able to test whether financial risk preference mediates the link between morningness and stock market participation (Hypothesis 6). Table 4.8 reports the results of this mediation model. The results indicate that the morning chronotype is positively associated with financial risk preference (path a: coefficient is 0.745, SE=0.277, t=2.688). This finding contradicts that of Wang and Chartrand (2015). In addition, financial risk tolerance is positively associated with stock market participation (path b: coefficient is 0.293, SE=0.059, z=4.934). Since a-path and b-path are significant, the results indicate that there is a mediation effect. To further test the significance of this mediation effect (indirect effect a*b), I use the bootstrapping method with bias-corrected confidence estimates (Preacher and Hayes, 2008). Next, the 95% confidence interval of the indirect effect is taken with 5,000 bootstraps resamples (Preacher and Hayes, 2008). If the confidence interval of the estimator does not contain 0, it shows that the indirect effect is significantly different from zero. The results of the bootstrap test showed that financial risk preference mediates the link between morningness and stock market participation (indirect effect=a*b=0.219, SE=0.096, 95% CI =from 0.054 to 0.425). Moreover, when adding financial risk preference, the relationship between the morning chronotype and stock market participation turns becomes non-significant (path c`: coefficient is 0.543, SE=0.351, Z=1.551). This result means that financial risk preference is a full mediator (see Figure 4.6). To summarize, the results are in support of Hypothesis 6. In other words, financial risk preference is one channel through which morningness positively influences the likelihood of stock market participation.

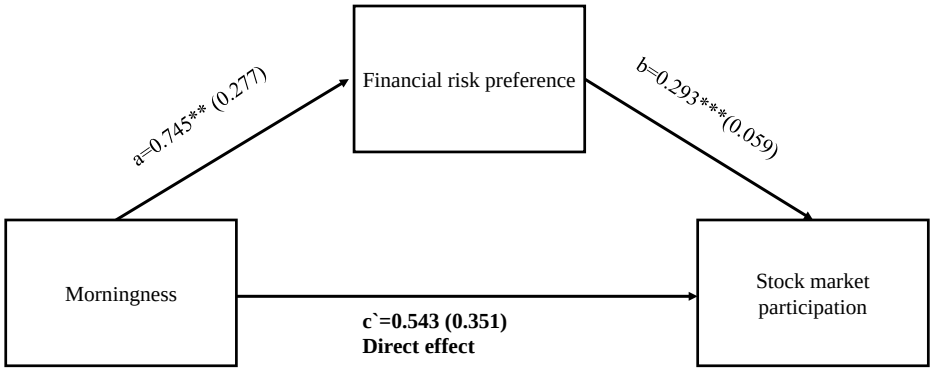


Figure 4.6: The indirect effect of morningness on stock market participation through financial risk preference is statistically significant (a*b= 0.219, SE=0.096, 95% CI=[0.054, 0.425]). Bootstrapped resample is 5,000. *p<0.10,**p<0.05, ***p<0.01.

4.4.6 The moderating role of income on the indirect effect of morningness on stock market participation (H7 and H8)

Table 4.9 summarizes the statistical results of the moderation model that investigates the moderating effect of monthly income on the relationship between morningness and financial risk preference. The dependent variable is financial risk preference. The independent variable is morningness, and the moderator is monthly income. I grand-mean-center the moderator (Monthly income) and the independent variable (Morningness) according to the approach proposed by Aiken et al. (1991). In particular, after the effects of the control variables and the main effects of time preference are accounted, I find that the coefficient of cross product between monthly income and morningness is 0.209, SE=0.286, t=0.73, p=0.463, indicating that there is no significant interaction effect in relation to stock market participation. The results do not support Hypothesis 7.

Table 4.9 The moderation effect of monthly income on the relationship between morningness and financial risk preference.

Dependent variables: Financial risk preference	Monthly income as a moderator in OLS regression			
Variables	Coefficients	SD	t-statistic	p-value
Constant	7.772***	0.702	11.08	0.001
Age	-0.232	0.186	-1.25	0.214
Male	0.766***	0.180	4.25	0.001
Married	0.381*	0.228	1.67	0.095
Education	-0.144	0.160	-0.90	0.369
Morningness	0.713***	0.269	2.64	0.008
Monthly_income	0.352***	0.095	3.70	0.001
Monthly_income*Morningness	0.209	0.286	0.73	0.463
Pseudo R2	0.115			
The Number of Observations	455			

Note: The dependent variable is financial risk preference. Monthly_income is the moderator. This table reports the coefficients from the OLS regression examining the moderating effect of monthly_income on the relationship between morningness and financial risk preference. The sample is China residents who have been working for 3 to 8 years, randomly sampled with the online survey. *, **, and *** indicate significances at the 10% level (2-sided), 5% level, and 1% level, respectively.

Table 4.10. The conditional indirect effect of morningness on stock market participation.

	Financial risk preference			Stock market participation		
Variables	Coefficient	SE	t	Coefficient	SE	z
Constant	7.866***	0.722	10.899	-4.974***	0.962	-5.168
Age	-0.232	0.188	-1.231	0.076	0.233	0.330
Male	0.766***	0.183	4.180	0.600***	0.232	2.587
Married	0.381	0.232	1.647	0.487*	0.255	1.911
Education	-0.144	0.164	-0.876	0.693***	0.199	3.474
Morningness	0.713**	0.280	2.545	0.549	0.351	1.566
Monthly_income	0.379***	0.093	4.070			
Financial preference				0.303***	0.059	5.174
Monthly_income*Morning type	0.209	0.305	0.688			
R2	0.115					
Pseudo R2				0.116		
Number of observations	455			455		
Moderator: Monthly_income	Bootstrapping indirect effect		Boot SE		95% CI (LL, UL)	
Low (-1 SD from mean)	0.146		0.137		-0.111	0.438
Average (0 SD from mean)	0.216		0.095		0.044	0.420
High (+1 SD from mean)	0.286		0.143		0.044	0.601
Index of moderated mediation						
Mediator	Index	SE(Boot)			95% CI (LL, UL)	
Financial preference	0.064	0.094			-0.104	0.272

Note: Unstandardized regression coefficients are reported; bootstrap sample size=5,000. CI=confidence interval; LL=lower limit; UL= upper limit. * indicates p<0.1, ** indicates p<.05, and *** indicates p<0.01.

To explore whether the indirect relationship between morningness and stock market participation through financial risk preference would be conditional on the moderator variable of monthly income for the path from morningness to financial risk preference, I use the bootstrap methods proposed by Hayes (2013) to test this hypothesized first-stage moderated mediation model (Hypothesis 8). The first step is to examine the interactive effect of morningness and monthly income on financial risk preference. The results suggest that the interaction term between morningness and monthly income is not significant (b=0.209, SE=0.305, t=0.688, p>0.05). The second step is to investigate the conditional indirect effects at 1 standard deviation above (high monthly income), at 0 standard deviation from (average monthly income), and at 1 standard deviation below the mean of the moderator (low monthly income). Table 4.10 reports the details of the moderated mediation model test.

Since the interaction between morningness and monthly income is not significant and the index of moderated mediation model is not significant (Index=0.064, SE=0.094, 95% CI=[-0.104, 0.272]), the results indicate that there is no conditional indirect effect between morningness and stock market participation through financial risk preference.

To summarize, the findings above indicate that morning chronotype influences stock market participation fully through financial risk preference and that this indirect effects do not vary at different levels of monthly income.

4.4.7 Robustness check

I changed the dichotomously measured morningness in the benchmark analysis to a continuum scale because Chelminski et al. (1997) proposed the idea of using continuum scale of morningness-eveningness, which may provide richer information regarding the hypothesized relationships. I also used a different single question also proposed by Dohmen et al. (2011) to measure risk preference, which can generate an all-around factor to predict risky behaviour. In addition, I added both risk and time preference measures in all settings of the regression and path analyses, as risk and time are intertwined. It would be problematic to isolate risk attitude, when studying time preference (Andreoni and Sprenger, 2012), because uncontrolled risk preference can create present-biased choices or behaviours. By changing the measures of the key variables of interests, I intend to verify the robustness of our results.

The analysis first shows that circadian rhythm is negatively associated delinquent credit debt payments, and time perspective partially mediates this relationship. In addition, income moderates this indirect effect on the path from time preference to delinquent credit debt payments. Second, risk preference still fully mediates the positive association between circadian rhythm and the likelihood of participating in the stock market. Consequently, the results are still robust after changing the measurements of key variables, which enhances the empirical evidence supporting the hypothesized relationships. For brevity purposes, I report the details of robustness check in Appendix C.

4.5 Discussion

The first goal of the current study was to explore the effects of circadian rhythm on financial behaviours, including revolving credit card payments and stock market participation as well as the possible mechanisms (i.e., channels) through which theses effect take place. In particular, I aim to get a better understanding of the links between 1) circadian rhythm, time preference, and delinquent credit card payments as well as the relationships between 2) circadian rhythm, financial risk preference, and stock market participation. In fact, I investigated that how morningness is related to the likelihood of delinquent credit card payments, and whether time preference is one channel through which morningness indirectly affects the likelihood of delinquent credit card payment. In addition, I test how income moderates the mediating relationship between morningness, time preference, and delinquent credit card payments. Partially as expected, the survey results empirically demonstrate that morningness is negatively associated with the likelihood of delinquent credit card payments. Time preference is one of the channels through which that morningness influences the likelihood of incomplete credit

card debt. Moreover, this indirect relationship is identified to be significant if and only if individuals have median or high level of monthly income.

The second goal of this paper was to examine the effects of circadian rhythm on stock market participation and explore the plausible channels through which these effects occur. Specifically, I examine how morningness is associated with the likelihood of stock market participation, and whether financial risk preference is one channel through which morningness indirectly influence the likelihood of stock market participation. Additionally, I test whether income moderates the mediating relationship between morningness, financial risk preference, and delinquent credit card debt. The results confirm that morningness only influences the likelihood of participating in the stock market through financial risk preference. An addtional finding is that the results indicate that morningness is positively associated with financial risk preference, which contradicts to the previous studies that reported morningness is inversely related to risk taking (Killgore, 2007; Maestripieri, 2014; Wang and Chartrand, 2015). Finally, neither morningness is directly associated with stock market participation nor income moderates the indirect relationship between morningness, financial risk preference, and participation in the stock market.

These findings have some important theoretical and practical implications.

4.5.1 Theoretical implications

In general, I extend the literature by adding the knowledge that circadian typologies can influence financial behaviours through individual economic differences (i.e., time preference and financial risk preference), and I provide an informative picture regarding the relationships between them based on inferential statistics.

I contribute to this stream of literature by recognizing that morning-type people can inhibit the probability of delinquent credit cards and time preference represents one of the channels through which this occurs. The research expands the present understanding of the functional effect of morningness-eveningness (Piffer et al., 2014) by theoretically and empirically suggesting the relationship between morningness and the likelihood of delinquent credit card payments. I propose and find at direct negative association between morningness and delinquent credit card payment, which makes it clear that the morning chronotype significantly suppresses the likelihood of revolving credit card debt. One possible mechanism for this association is self-control because morningness prompts individuals to be more self-regulated (Milfont and Schwarzenthal, 2014), which is negatively associated with non-payment of credit cards and the financial burdens of debt (Gathergood, 2012). Another possible mechanism for

this link could be through a character inventory. Morning larks are more prone to being persistent (Randler and Saliger, 2011), conscientious (Randler, 2008a), and proactive (Randler, 2009) compared with evening owls. In particular, proactive people tend to examine, expect, and diminish the effects of potential problems in the future, avoiding them as much as possible (Aspinwall et al., 2002; Aspinwall et al., 2005). As a result, these people are more likely to avoid delinquent credit card debt. I also hypothesize and the results reveal that time preference partially mediates the relationship between morningness and delinquent credit card payments, thus replicating the association between morning chronotype and time perspective (Cinan and Dogan, 2013; Nowack and van der Meer, 2013), and expanding upon the initial work by using a Chinese sample. Morning larks appear to focus on future target attainment and suspend gratification (Milfont and Schwarzenthal, 2014). The study also extends the knowledge regarding the effect of morning-type on various behaviours that were mainly in the health and education fields (Fleig and Randler, 2009; Nakade et al., 2009; Goldstein et al., 2007; Wittmann et al., 2010; Susman et al., 2007; Piffer et al., 2014) to the financial field. An additional highlight is that the mediating role of time preference in the morningness-delinquent credit card payment relationship goes beyond the effects of the demographic predictors that I control for in the analyses. Furthermore, by integrating insights from theories on time preference and credit card borrowing (Laibson, 1997; Fehr, 2002; Meier and Sprenger, 2010; Heidhues and Koszegi, 2010), and from theories on income and credit card debt (Calem and Mester, 1995), I propose and investigate how income moderates the mediating role of time preference on the morningness-delinquent credit card payments relationship. The findings show that time preference induced by a morning-oriented rhythm result in less likelihood of revolving credit card debt at mean and low levels of income. Specifically, the possible reason for the results regarding users of credit cards with low and mean levels of income is that they are concerned about the level of their financial debt, given the compounding rate of credit card debt. Because their financial situation is vulnerable to high interest rates, which will increase based on the amount of debt (Kim and DeVaney, 2001). Another concern of people with low and mean levels of income may be their personal credit over the long term. Given the evidence that income is positively associated with credit card balances at average and low levels of income (Calem and Mester, 1995), an increase in income for these groups of people may result in higher credit-card debt. Consequently, to maintain the utility of personal credit, future-oriented people with low and average levels of income will try their best to avoid any default-related behaviours. However, individuals with high level of income appear to be much less likely to be in a weak position such that their financial situation would be profoundly harmed due to unpaid credit card debt. For that reason, for this group of people, time preference is not a mediator for the likelihood of delinquent credit card payments.

Another important contribution of this study is to identify that circadian rhythms can exert influence on the probability of owning equity through financial risk preference. I advance the current understanding of the effect of morningness on risk behaviours related to investment matters by empirically investigates whether and how morningness affect financial risk taking and in turn influences stock market participation. I also offer possible explanations from multiple perspectives for why morning larks are prone to more risk taking, which can lead to the sequential outcome of owning equity. First, contrary to expectations (Wang and Chartrand, 2015), I find that morningness people are more likely to engage in financial risk taking. Since genetic factors (Hur, 2007) can explain a large amount of the variance of circadian typologies, and biological and physiological factors (Buschkens et al., 2010; Roeser et al., 2012) are significant predictors of them, I am able to provide a plausible explanation. In the literature, Kandasamy et al. (2014) argued that acute cortisol lift-up is associated with increased physical arousal (Dallman and Bhatnagar, 2010), enhanced memory recall (Lupien et al., 2002), higher frequency of interaction with dopaminergic paths in the brain, promoted learning, induced behaviours, and sensation seeking. In addition, Cueva et al. (2015) clarified that cortisol and testosterone lead to increased financial risk preference. Therefore, the possible channel could be cortisol. Empirical research has suggested that the mean cortisol level of morning-type people are larger than the mean cortisol level of evening-type ones (Bailey and Heitkemper, 1991). Compared with evening owls, morning larks may have a higher level of cortisol in their first hour after waking (Kudielka et al., 2006). In addition, morningness people have moderately greater cortisol concentrations after waking than eveningness individuals (Griefahn and Robens, 2008; Randler and Schaal, 2010). Because cortisol tends to directly increase risk taking, it could shed light on the positive association between morning-types and financial risk preference. Another possible channel could be testosterone, which could induce people to be more optimistic about risk regarding price changes in the financial market (Cueva et al., 2015), although Randler et al. (2012) at the first place put forward that testosterone is positively associated with evening-types in young adults between 20 and 30 years of age. Given this contrasting evidence, I do not deny that testosterone may also contribute to the higher level of risk taking among morning-oriented people, as my sample is quite heterogeneous from a demographic perspective. For example, my sample spans a larger age range (18 to 44 year old) and is a mixed gender sample rather than only males. A possible third channel is a happy mood. On the one hand, compared with evening owls, morning larks have higher levels of positive mood in both the young and old age groups, which make them happier (Biss and Hasher, 2012). When evening owls force themselves to get up early and produce in the daytime, it leads to some extent of sleep loss and emotional stress and in turn they are less happy. On the other hand, being happy is positively associated with a greater level of financial risk taking (Grable and Roszkowski, 2008). Positive emotional states, such as excitement and happiness, prompt

individuals to take risks and to have more confidence in their abilities when making financial decisions (Kuhnen and Knutson, 2011). Second, with regard to the finding that financial risk preference fully mediates the relationship between morning-type people and owning equity as a behavioural consequence, it is straightforward to argue that financial risk preference is a unique channel. Empirical research in the risk attitude domain suggests that risk tolerance is positively associated with risky behaviours, including holding equity, which might be useful in many applications with a variety of different datasets (Barsky et al., 1997). Risk attitudes can explain the variance in risky behaviours, and the willingness to take risks in financial matters predicts the probability of owning stock much better than risk predictors do in other contexts (Dohmen et al., 2011). By integrating the evidence from the literature described above, I articulate the importance of the financial-risk taking process mechanism that is intrinsically embedded in the connection between morning-types and the probability of owning stock.

Empirical studies in the behavioural finance domain has focused on investigating the antecedents and outcomes of interest, in this case in terms of investment behaviours. Morningness-eveningness denotes biological rhythms, which is a temporality of humanity that cannot be backward, but only as an elemental level (Stolarski et al., 2013). I contribute by linking circadian rhythms with risk preference and time preference. Apprehending individuals' decision-making both under risk and over time represent two fundamental domains of economic analysis (Tanaka et al., 2010) and policy design (Charness et al., 2013). However, they are distinctive conceptions (Gafni and Torrance, 1984; Andreoni and Sprenger, 2012). Prospect theory (Kahneman and Tversky, 1979) takes risk attitude as a free parameter, while Zimbardo and Boyd (1999) defined time preference as a temporal category. It is therefore of benefit to explore their process mechanisms. Although cross-sectional research based on regressions have limitation to clarify causality (Levin, 2006), I still have provided some reasonable explanation regarding the path from the circadian typologies to risk and time preferences in the above two paragraphs. Furthermore, I extend the empirical literature by identifying the mediating mechanism of risk and time preference between circadian rhythms and financial behaviours and the moderation mechanism of income in the indirect relationship between morningness and delinquent credit card payments through time preference. As such, I add fine-grained knowledge about whether, how and when circadian rhythms influence financial behaviours in a sequential process.

4.5.2 Practical implications

Given the evidence that morning larks are less likely to have revolving credit balances compared with evening owls. Morningness is indirectly and positively associated with the

likelihood of participation in the stock market. From a financial perspective, evening-types do not seem to be in an advantageous position. Because in the short term, having delinquent credit card debt lead to higher interest rates, financial penalties, and higher outstanding balances (Elliehausen et al., 2007), and in the long-term, such behaviour harms financial well-being. In addition, non-participation in the stock market over the long term is costly because the stock premium is more likely to accumulate long-term benefits in personal savings, which in turn produce personal well-being. Therefore, I have following practical implication. For individuals, evening-oriented people should prevent from adopting poor loan payment habits in order to avoid unpaid credit debt, and they should pay loans back on time. In addition, empirical evidence indicate that evening owls may shift their sleep-wake time schedule to be closer to morning larks. Although the circadian chronotypes are time stable, this does not mean this characteristic is unchangeable. As a result, I anticipate that evening owls could have longer daytime to process information and deal with things, and become more proactive, more conscientious, as well as improve their mood, which may contribute to a higher likelihood of participation in the stock market. In addition, financial institutions can assess the chronotypes of customers as predictors of their behaviours. For example, financial institutions could remind evening-oriented customers about the due dates of their loan payment slightly more often but still in a soft manner, such as through email or app notifications. Furthermore, financial organizations could recommend customized portfolio according to customer' circadian type. For example, financial risk involved with the suggested financial products for morning larks could be slightly higher than those proposed for evening owls.

4.5.3 Limitations

Some limitations of this paper warrant mention. First, the results regarding the path from morningness-eveningness to risk attitude (time perspective) are explanatory. Although it is difficult to draw conclusions about the exact direction of the relationship between chronotypes and preferences in cross-sectional research such as this study, chronotypes are much more likely to be the premises because chronotypes are biologically driven. In particular, chronotypes are associated with many physiological factors (Buschkens et al., 2010; Roeser et al., 2012) and can be predicted by genetic factors (Hur, 2007). Another reason is that physiological factors and parts of temperament form individual heterogeneity in constructs (e.g., time preference and risk preference). Thus, chronotypes are more likely to be the start point of the relationship. These empirical findings and theoretical considerations provide support for the specific arrangements and the path sequences of the variables examined in the current study. To move forward by making definitive arguments that these mechanisms exist, longitudinal studies should further test the proposed hypotheses. Second, the sample was limited to workers who

have been working for 3 to 8 years, which hinders the generalization of the results to the general population. Third, the sample size could be larger and it is beneficial to increase representativeness of the sample by collecting more observations from people whose education attainments are equal to or less than high school. Moreover, the age variable used particular cut-off points to categorize the sample, such as 18-29, 30-44 and 45-54. This classification empirically explained little or no significant amount of the variance in the outcome variables in the present study. I recommend that future studies measure age in its continuum form. In addition, using the sample with participants who have been working for 3 to 8 years resulted in significant bias toward morning-type and intermediate-type because I have only 6 observations of evening owls of the 455 total. Thus, I were limited to investigating the effect of morningness on preference constructs, and in turn on financial behaviours. However, I believe I have provided a good start for examining the links between chronotypes, time perspective and risk attitude, and financial-related behaviours. Another bias problem may arise because Chinese people tend to be more morning-oriented (Carciofo et al., 2012), and chronotypes are environmentally dependent (Randler, 2008b). Future research could validate the current study by sampling another country with a different culture and environment, such as an individualism-oriented country, which is more likely to generate a sample with a wider variety of chronotypes. Consequently, examining the effect of eveningness on preference constructs and financial behaviours would be a good extension to the present study. Furthermore, some of effect sizes were low or moderate. For example, the indirect effect between morningness and delinquent credit card payments is -0.186, indicating the probability of morning larks to own equity is 18.6% lower than the probability of people in the other circadian typologies. Although this situation is similar to those in previous studies that focus on personality outlines of circadian rhythm and sex groups, typically in psychological research (Ferguson, 2009), I must be careful to make predictions. Finally, personality traits were not controlled for in the current study, which may raise concerns regarding a possible confounding effect of personality traits in the path from chronotypes to financial behaviours. Because recent studies have reported that personality traits are significant predictors of stock market participation (Conlin et al., 2015) and are associated with credit card debt (Yang and Lester, 2014). Nevertheless, integrating the association between circadian typologies and personality traits (Antúnez et al., 2014) and the discussion above regarding the underlying mechanisms of the circadian chronotypes' effects on behaviours, chronotypes are still much more likely to be the starting point of the path due to its genetic predetermined nature. Therefore, future studies studying on the relationship between circadian typologies, preferences and behaviours should incorporate personality traits to isolate their effects, and to provide a more accurate and proper model.

4.6 Conclusion

In summary, to further understanding of the influence of circadian rhythms on specific financial behaviours (e.g., delinquent credit card payments and stock market participation), I integrated and examined the role of time perspective and risk preference in a sequential process. I conducted regressions and path analysis based on an online survey sample representing the group of people who have been working for three to eight years in China. The findings show that compared to evening-type and neither-type individuals, morning larks are much less likely to have revolving credit card debt and one of the channels is the individual's time perspective. However, time preference only partially mediates the relationship between morning chronotype and the probability of having revolving credit card debt when individual' income level is at average and low, for the path from time preference to delinquent credit card payments. The present study helps to clarify the underlying mechanism and the condition in the link between circadian typologies and revolving credit card debt. Another novel finding is that risk preference fully mediates the relationship between morningness and the probability of owning equity. Therefore, the current study is also helpful to elucidate the unique channel and mechanism through which being morning-oriented exerts an influence on stock market participation. Furthermore, the results could be a valuable tool for financial professionals who could consider circadian rhythms when developing and introducing financial products or financial services to morning-type, intermediate-type, and evening-type populations. Future research could extend by studying the relationship between chronotypes, preference constructs, and financial behaviours by adding sampling frames, such as including aging cohorts, general populations in other countries. Longitudinal studies are particularly of use to validate the proposed relationships.

Chapter 5 Conclusion

The concept of decision-making has been a central focus of intellectual pursuits since the beginning of human civilization. Behavioural finance is a discipline that combines psychology theories to explain irrational behaviours, caused by individual-level cognitive biases, and recent studies have called for future research to test the effects of personal attributes on financial decisions and financial outcomes (Hirshleifer, 2015). Meanwhile, biological psychologists and neuroscientists have provided evidence of the link between biology and decision-making (Soon et al., 2008; Bode et al., 2011). Therefore, it appears that psychological factors and biological factors can both influence decision-making.

The first paper (Chapter 2) examined the effect of cognition on the change in US and UK household assets shares and diversification. The study was based on two national longitudinal surveys, the Health and Retirement Survey (the US) and the English Longitudinal Survey of Aging (the UK). These surveys provided ample portfolio, and demographic information for a broad range of covariates, which reduces omitted variable problem and establishes a comprehensive basis for analysis. In addition, these survey data are panel data that control for unobserved heteroscedasticity and enhance the accurate inferences of the model parameter (Hsiao, 2007). On the one hand, older cohorts in both the US and the UK gradually shifted their financial portfolios away from equities and safe assets and added a fraction of their portfolios to retirement accounts. I further detected that the financial wealth of UK households slightly increased on average during the period 2002-2010, and this positive change even existing during the volatile financial period (2008-2010). However, US households on average experienced a decline in wealth over the years 1998-2010, especially during the volatile financial period (2008-2010). On the other hand, I examined whether cognition predicts the change in shares of assets, and the results generally supported this expectation. First, the results showed that there was a negative correlation between cognitive abilities and the share of financial assets held in safe assets. Second, the results indicated that heads of households with higher cognition levels preferred to have a larger percentage of their financial assets in retirement accounts, such as IRAs in the US and ISAs in the UK. Third, in households with low and median levels of financial wealth, these relationships were consistently significant. In other words, financial wealth moderated the relationship between cognition and the percentage of investments held in retirement accounts. In addition, heads of households with higher cognitive abilities are more likely to diversify their financial assets. Moreover, although I cannot empirically affirm the appropriate channels through which cognitive abilities influence household financial portfolios, this could be explained based on three possible channels,

including risk preference and time preference, overconfidence, and human capital investment, as proposed by Christelis et al. (2010). I deduced that the cost of human capital caused by information barriers was the most likely channel. Finally, another finding was that rather than cognitive abilities affecting the share of investments in risky assets, which was consistent with a previous study (Christelis et al., 2010), educational attainment significantly predicted the variance in the proportion of risky assets in financial portfolios. This paper complements the theory regarding the correlation between cognitive abilities and household portfolio choices, by documenting how cognitive abilities contribute to changes in the aging cohort's asset allocation and diversification in US and UK households, which subsequently contribute to preventing financial wealth decay and maintaining the financial well-being of the elderly. I outline practical implications for consumers, firms, and the government to protect against cognitive decline due to aging and to maintain good financial literacy.

The second paper (Chapter 3) examined whether and how perfectionism predicted the variance in financial risk tolerance, wealth accumulation and gambling behaviours. I used an online survey of 661 US residents randomly sampled from the general population. Perfectionism is a multi-dimensional personality trait that yields an interpretation of individual differences in attitudes and performance (Sherry et al., 2016). Perfectionistic striving captures good characteristics, such as endurance, performance, achievement and positive affect, whereas perfectionistic concerns refer to negative characteristics, such as fear of failure, low self-esteem and low self-efficacy. First, financial risk tolerance increase with the level of perfectionistic striving, but the results did not indicate that evaluative concerns are directly associated with financial risk tolerance. Second, striving (evaluative concerns) was associated with increased (decreased) investment knowledge, which was in turn associated with increased (decreased) liquid wealth. Third, the magnitude of the indirect effect of striving on liquid wealth is greater than the magnitude of the indirect effect of evaluative concerns on liquid wealth. Subsequently, I reported two channels through which perfectionistic striving influences financial risk tolerance. The first channel is investment knowledge itself, and the second channel is investment knowledge followed by liquid wealth. The direct effect of striving on financial risk tolerance consistently exists and is larger than the indirect effects. Furthermore, perfectionistic concerns are negatively and indirectly associated with financial risk tolerance through the channels of investment knowledge itself, and investment knowledge followed by liquid wealth. I did not detect any direct relationship between evaluative concerns and financial risk tolerance. Finally, the results indicate that perfectionistic concerns inhibit monthly gambling expenditures, both in their absolute and relative forms. These findings remained with robustness checks. By reporting these relationships, this preliminary study has some important implications for theoretical and empirical research in behavioural finance, together with

practical implications for financial well-being and life satisfaction. First, it strengthens the argument that perfectionism has both active and negative facets, which can cause positive and adverse outcomes, respectively, such as increased and decreased wealth accumulation, and increased and reduced risk tolerance. Second, empirically, it might be helpful to reduce the confounding effects by adding wealth accumulation as a covariate when investigating the associations between perfectionism and other variables of interests simultaneously. With respect to policy implications, these findings could help to develop deliberate interventions to support individuals who report poor financial well-being, poor life satisfaction, and a high level of negative affect. These interventions could include professional financial courses, adaptive perfectionism-oriented psychological counselling and education, which could not only increase individuals' investment knowledge, but also shape their standard of achievement and shrink their propensity to be afraid of making mistakes. However, this study has some limitations. First, because of its preliminary nature, the paper only reported one channel through which perfectionism can predict wealth accumulation, and revealed two channels through which perfectionism can influence financial risk tolerance. Second, this paper could not identify the reasons why striving drives financial risk tolerance and why evaluative concerns do not. Third, these findings were derived from a sample of only a country and a cross-sectional study, which may not be sufficient to make causal inferences. Future research should try to extend the study in the following points. First, researchers can explore additional channels through which perfectionism influences financial risk tolerance. Second, it would be valuable to increase the external validity of this study by using a sample from another country to examine whether similar findings are found. Third, a longitudinal analysis would be helpful to solidify arguments regarding studied relationships. Finally, future researchers could investigate the effect of perfectionism on other heterogeneous preferences, such as time discounting and uncertainty aversion.

The third paper (Chapter 4) examined the effect of circadian typologies on delinquent credit card payments and stock market participation through preference channels. I conducted this study by using regression and path analysis based on an online survey sample of a group of people who have been working for 3 to 8 years in mainland China. The first finding revealed that, compared with people in other circadian typologies, morning larks are much less likely to have delinquent credit debt, and one of the channels in this relationship is the individual's time perspective. In addition, time preference partially mediates the relationship between the morning chronotype and delinquent credit card payments, only when individuals' income was at average to low level, in the path from time preference to delinquent credit card payments. The study helps to clarify the underlying mechanism and proposes conditions in the relationship between the morning chronotype and delinquent credit card payments. Another novel finding

is that risk preference fully mediates the link between morningness and the probability of owning equity. Therefore, the study helps to elucidate the unique channel through which being a morning type influences stock market participation. Furthermore, since these findings are based on a sample of experienced workers, financial professionals should consider circadian rhythms when developing and introducing financial products or financial services to morning-type, intermediate-type, and evening-type customers. Future research could extend this study by examining the relationships between morningness-eveningness, preference constructs, and financial behaviours in wider populations, such as in the aging population or populations in other countries. Finally, longitudinal studies would be particularly powerful for testing the proposed relationships.

The evolution of research on human decision-making over the last few decades has moved from behavioural economics to neuroeconomics, and in turn to decision neuroscience due to the rise of biology in this research area (Bossaerts and Murawski, 2015). The present thesis attempted to explain the individual heterogeneity in risk and time preferences, asset allocation strategies, and particular financial behaviours from both psychological and biological perspectives. I may provide a slight inclination that biological factors seem to be more likely the causes of financial decisions. If biological data actually can advance the knowledge about the nature of human decision-making (Bossaerts and Murawski, 2015), it would be rewarding for future research to integrate behavioural and biological paradigms to comprehend the heterogeneity in human decisions in not only the financial domain but also other domains.

Appendices

Appendix A

US biennial panel survey: Health and retirement survey (Chien et al., 2015)

Name of variable	Details	Score
Cognition	This variable measures cognitive capability of participants by capturing word recall and mental status summary. Word recall includes the immediate and delayed word recall. Immediate word recall counts the number of words recalled correctly from a 10- or 20-item list (0-10). Delayed word recall counts the number of words recalled correctly from a 10- or 20-item immediate recall list after a delay of approximately 5 minutes during which other survey questions are answered (0-10). Mental status summary includes serial sevens, backwards counting, object naming, date naming, and president/vice-president naming tasks. Serial sevens indicates the number of correct subtractions in the serial sevens test, which asks the individual to subtract 7 from the prior number, beginning with 100, for five trials. Correct subtractions are based on the prior number given, so that even if one subtraction is incorrectly calculated, subsequent trials are evaluated on the given (perhaps incorrect) answer (0-5). Backwards counting indicates whether the respondent was able to successfully count backwards for 10 continuous numbers, beginning with 20 and 86. Two points are given if the respondent is successful on the first try, one point is given if the respondent is successful on the second, and zero point is given if the respondent is not successful on either try (0-2). Object naming assesses whether the respondent was able to correctly name two objects, cactus and scissors, based on a verbal description (0-2). The description were: "What do you usually use to cut paper?" and "What do you call the kind of prickly plant that grows in the desert?" Date naming indicates whether the respondent correctly stated the date on the day of the survey, including the day of the month, month, year, and day of the week (0-4).	[0,35]

	President/vice-president naming determines the respondent's ability to provide definitions of five given words. There are two sets of words, one of which is randomly assigned at the respondent's first interview. The two sets are then alternated in subsequent waves. The two word sets are as follows: 1) repair, fabric, domestic, remorse, plagiarize; and 2) conceal, enormous, perimeter, compassion, audacious. Possible scores for each word are perfectly correct (=2), partially correct (=1), and incorrect (0) (0-2).	
Share of risky assets	This variable measures the share of investment in risky assets, which is equal to the quotient of the value of risky assets divided by the value of total financial assets. Two questions reveal whether the respondent owns any stocks or mutual funds and if so, their value: "Do you have any shares of stock or stock mutual funds?" "If you sold all that and paid off anything you owed on it, how much would you have?"	[0,1]
Share of IRAs	This variable measures the share of investment in individual retirement assets (IRAs), which equals to the quotient of the value of IRA accounts divided by the value of all financial assets. Two questions reveal whether the respondent owns any IRA or Keogh accounts and if so, the value of them. "Do you currently have any money or assets that are held in an Individual Retirement Account, that is, in an IRA or KEOGH account?" "How much in total is in all those accounts?"	[0,1]
Share of risk-free assets	This variable measures the share of investment in risk-free assets, which equals to quotient of the value of risk-free assets divided by the value of all financial assets. Four questions reveal whether the Respondent owns any checking and savings accounts, money market funds, CDs, government savings bonds, or treasury bills and if so, the value of them. "Do you have any money in checking or savings accounts, or money market funds?"" "If you added up all such accounts [for you and your partner], about how much would they amount to right now?" "Do you have any money in certificates of deposit, government savings bonds, or Treasury bills?" "If you added up all such accounts [for you and your (husband/wife/partner)], about how much would they amount to right now?" (reported in US dollars)	[0,1]
Log (Financial wealth)	This variable is the log transformation of the sum of the net values of risky assets (stocks and mutual funds), IRAs (assets in IRAs and Keoghs), risk-free assets (checking and savings accounts, money market funds, CDs, government savings bonds, and Treasury), and bonds (corporate, municipal and foreign bonds, and bond funds) (reported in US dollars).	[0, 18)
Log (Household income)	This variable is the the log transformation of the sum of all income in a household, including respondent and spouse's individual earning, individual income from employer pension or annuity, individual income from social security DI or SSI, individual income	[0, 18)

	from social security retirement, individual unemployment or workers compensation, individual income from other government transfers and household capital income with other household income (reported in US dollars).	
Log (Housing wealth)	This variable is the log transformation of the sum of net values of primary residence, business, vehicles, secondary home residence, other property and other physical assets after paying all mortgages/land constracts and other home loans for primary residence and secondary residence (reported in US dollars).	[0,18.3)
Log (debt)	This variable is the log transformation of the sum of credit card balances, medical debts, life insurance policy loans, and loans from relatives (reported in US dollars).	[0, 16.1)
Age	The age of the head of the household.	[50, 110)
Number of children	The number of dependent children in the household.	[0, 16]
Retirement	The retirement status of the respondent.	1 or 0
Physical	The number of chronic diseases that the respondent has, including high blood pressure, diabetes, cancer, chronic lung disease, heart attack, stroke, and arthritis.	[0, 7]
College	It indicates whether the head of the household has a college education attainment.	1 or 0

UK biennial panel survey: English longitudinal survey of aging (Phillips et al., 2017)

Name of variables	Details	Score
Cognition (TR20)	This variable measures the cognitive abilities of participants, capturing the information of word recall only. Mental status is excluded from the ELSA data because this survey did not test serial sevens, backwards counting, object naming, or President/Vice-President naming tasks until 2014. To implement longitudinal study, I use word recall as the proxy for cognitive abilities. Word recall includes both immediate and delayed word recall, which are both cognitive measures. Specifically, immediate word recall counts of the number of words from a 10-word list that were recalled correctly (0-10). Delayed word recall counts the number of words from the 10- or 20-word immediate recall list that were recalled correctly after a delay of approximately 5 minutes during which other survey questions were answered (0-10).	[0,20]
Share of risky assets	The share of investment in risky assets, which equals to the quotient of the value of risky assets divided by the value of all financial assets. The value of risky assets is the net value of stocks, shares, and investment trusts owned by the respondent and his/her partner.	[0,1]
Share of ISAs	The share of total financial assets invested in individual savings accounts (ISAs), which equals to the quotient of the value of ISAs divided by the value of all financial assets. The value of assets in ISAs is the total amount held by the respondent and his/her partner in their TESSA, the cash components of their ISAs, the stocks and shares component of their ISAs, and their personal equity plan(s).	[0,1]
Share of risk-free assets	The share of investment in risk-free assets, which equals to the quotient of the value of risk-free assets divided by the value of all financial assets. The values of risk-free assets is the total amount held by the respondent and his/her partner in a current and savings accounts at the bank, building society or elsewhere and in national savings accounts or certificates.	[0,1]
Log (Financial wealth)	This variable is the log transformation of the sum of net values of risky assets (stocks, shares, and investment funds), ISAs (ISA, PEPS, and TESSA), risk-free assets (checking and savings accounts), and bonds (bonds and bond funds) (reported in US dollars).	[0, 17）

Log (Household income)	This variable is the log transformation of the sum of all income in a household, including respondent and spouse's individual earning, family capital income, individual income from employer or private pension and annuity, individual income from public pensions, individual other government transfers, and individual other regular payments (reported in US dollars).	[0, 15）
Log (Housing wealth)	This variable is the log transformation of the sum of net values of primary residence, business, secondary home residence, other property and physical assets after paying all mortgages/land constracts and other home loans for primary residence and secondary residence (reported in US dollars).	[0.369, 17.97]
Log (debt)	This variable is the log transformation of the sum of credit card balances, loans from relatives, hire purchase agreements, personal loans, overdraft, mail order purchase agreements, DSS social fund loan or loan from a money lender.	[0.369, 12.63)
Age	The age of the head of the household.	[50, 90)
Number of children	The number of dependent children in the household.	[0, 16]
Retirement	The retirement status of the respondent.	1 or 0
Chronic diseases	The number of chronic diseases that the respondent has, including high blood pressure, diabetes, cancer, chronic lung disease, heart attack, stroke, and arthritis.	[0, 7]
College	It indicates whether the head of the household has college education.	1 or 0

Appendix B

The questionnaire of paper 2

Research Title: Does perfectionism affect individual financial risk tolerance, wealth accumulation, and gambling behaviour?

Participant Information Sheet

Please read this information carefully before deciding to take part in this research.

This is a research aiming to study whether perfectionism influences individual financial risk tolerance and if this link is moderated by financial literacy of ones who are 55 or more years old (Please make sure you meet these requirements). This questionnaire may take you 20 to 30 minutes to complete it. Your participation in this survey is very important because you will be contributing to one of the first studies about the relationship between perfectionism, financial risk preference, and financial literacy. There will be no risk in taking this survey. Your answers and personal information will be confidential. Your name and contact details will not be shown as it is not required from you to provide your name. Only the aggregate statistical data based all of your information will be presented in this research in terms of paper in the future. Data and results will be stored properly according to the Data Protection Act and saved in a locked cabinet or encrypted file in a password protected computer. My name is Di Wang and I am a researcher at Banking and Finance Research Group of Business School at University of Southampton. You have the right to withdraw from this survey at any time for any reason.

Participants may wish to contact:

1) The researcher, Di Wang (dw2n13@soton.ac.uk).

2) The research support officer, Ying Ying Cheung (risethic@soton.ac.uk);

3) Head of Research Governance. Telephone: 02380 595058. Email: rgoinfo@soton.ac.uk.

- ❍ Yes, I am willing to join in this survey.
- ❍ No, I do not want.

Demographic Information

Q3.1 What is your age?

Q3.2 What is your gender?

- ❍ Male
- ❍ Female

Q3.3 Place of Birth:

- ❍ North American
- ❍ South American
- ❍ Europe
- ❍ Australia/New Zealand
- ❍ Middle East
- ❍ West or Central Asia
- ❍ East, South, Southeast Asia
- ❍ Other

Q3.4 Country of Residence

Q3.5 Marital status:

- ❍ Single
- ❍ Common-Law Relationship
- ❍ Married
- ❍ Divorced
- ❍ Widowed

Q3.6 Number of dependents:

Q3.7 Highest Level of Education Attained:

- ❍ Less than High School
- ❍ High School Graduate or Equivalent
- ❍ Some college but No Degree
- ❍ Associate Degree
- ❍ Bachelor Degree
- ❍ Master Degree
- ❍ Doctorate

Q3.8 Employment Status

- ❍ Full-time
- ❍ Part-time
- ❍ Self-employed
- ❍ Business Owner
- ❍ Homemaker
- ❍ Retired
- ❍ Other

Q3.9 At what age do you plan to retire?

Q3.10 How much is your Annual Household Income before Tax in US dollar? (Average over last 5 years from all sources: salary, investment income, pension or social security, etc.)

Q3.11 What is the value of your Liquid assets in US dollar? (Liquid assets are cash or securities that can quickly be converted into cash. E.g. money in savings and/or chequing accounts, stocks, bonds, etc.)

Q3.12 What is the value of your Fixed Assets in US dollar? (Fixed assets are physical items that cannot quickly be converted into cash. E.g. real estate, vehicles, collections, furniture, equipment, etc.)

Q3.13 How much is your Outstanding loans and liabilities (Total Debt) in US dollar?

Q3.14 Please input the word 'stock market' in the space below:

Q3.15 What is your Ethnicity?

- ❍ White, European American, or European
- ❍ Black, African, or African American
- ❍ Others

Q3.16 What is your monthly expenses in US dollar?

Q3.17 How much money do you gamble per month in US dollar? (Include all types of gambling – lotteries, scratch tickets, casino, poker, sports gambling, etc.)

Q3.18 Over the next 2-3 year, your income will be:

- ❍ Very unstable
- ❍ Somewhat less stable than today
- ❍ As stable as today
- ❍ Somewhat more stable than today
- ❍ Very stable

Q3.19 Which statement best describes your investment knowledge?

- ❍ I have limited knowledge and rely exclusively on other sources (financial advisor, accountant, family, etc.).
- ❍ I understand basic investment principles but do not actively follow the financial markets.
- ❍ I have a general understanding of financial markets and follow their progress occasionally.
- ❍ I have a good working knowledge of financial markets and follow the markets actively.
- ❍ I have in-depth knowledge (which includes options and strategies), manage my own portfolio, and follow the financial markets daily.

Q3.20 How many years have you been investing?

Q3.21 Do you regard yourself as belonging to a religion?

- ❍ Yes
- ❍ No

Financial risk tolerance

Q4.1 The general, how would your best friend describe you as a risk taker?

- ❍ A real gambler
- ❍ Willing to take risks after completing adequate research
- ❍ Cautious
- ❍ A real risk avoider

Q4.2 You are on a TV game show and can choose one of the following. Which would you take?

- ❍ $1,000 in cash
- ❍ A 50% chance at winning $5,000
- ❍ A 25% chance at winning $10,000
- ❍ A 5% chance at winning $100,000

Q4.3 You have just finished saving for a “once-in-a-lifetime” vacation. Three weeks before you plan to leave, you lose your job. You would:

- ❍ Cancel the vacation
- ❍ Take a much more modest vacation
- ❍ Go as scheduled, reasoning that you need the time to prepare for a job search
- ❍ Extend your vacation, because this might be your last chance to go first-class

Q4.4 If you unexpectedly received $20,000 to invest, what would you do?

- ❍ Deposit it in a bank account, money market account, or an insured CD
- ❍ Invest it in safe high-quality bonds or bond mutual funds
- ❍ Invest it in stocks or stock mutual funds

Q4.5 In terms of experience, how comfortable are you investing in stocks or stock mutual funds?

- ❍ Not at all comfortable
- ❍ Somewhat comfortable
- ❍ Very comfortable

Q4.6 When you think of the word “risk”, which of the following words comes to mind first?

- ❍ Less
- ❍ Opportunity
- ❍ Uncertainty
- ❍ Thrill

Q4.7 This is an attention filter. Please select 'Stock'.

- ❍ Stock
- ❍ Bond
- ❍ Bank saving
- ❍ None of them

Q4.8 Some experts are predicting prices of assets such as gold, jewels, collectibles, and real estate (hard assets) to increase in value. Bond prices may fall; however, experts tend to agree that government bonds are relatively safe. Most of your investment assets are now in high-interest government bonds. What would you do?

- ❍ Hold the bonds
- ❍ Sell the bonds, put half the proceeds into money market accounts, and the other half into hard assets
- ❍ Sell the bonds and put the total proceeds into hard assets
- ❍ Sell the bonds, put all the money into hard assets, and borrow additional money to buy more

Q4.9 Given the best and worst case returns of the four investment choices below, which would you prefer?

- ❍ $200 gain best case; $0 gain/loss worst case
- ❍ $800 gain best case; $200 loss worst case
- ❍ $2,600 gain best case; $800 loss worst case
- ❍ $4,800 gain best case; $2,400 loss worst case

Q4.10 In addition to whatever you own, you have been given $1,000. You are now asked to choose between:

- ❍ A sure gain of $500
- ❍ A 50% chance to gain $1,000 and a 50% chance to gain nothing

Q4.11 In addition to whatever you own, you have been given $2,000. You are now asked to choose between:

- ❍ A sure loss of $500
- ❍ A 50% chance to lose $1,000 and a 50% chance to lose nothing

Q4.12 Suppose a relative left you an inheritance of $100,000, stipulating in the will that you invest ALL the money in ONE of the following choices. Which one would you select?

- ❍ A savings account or money market mutual fund
- ❍ A mutual fund that owns stocks and bonds
- ❍ A portfolio of 15 common stocks
- ❍ Commodities like gold, silver, and oil

Q4.13 If you had to invest $20,000, which of the following investment choices would you find most appealing?

- ❍ 10% in low-risk investments, 40% in medium-risk investments, 50% in high-risk investments
- ❍ 30% in low-risk investments, 40% in medium-risk investments, 30% in high-risk investments
- ❍ 60% in low-risk investments, 30% in medium-risk investments, 10% in high-risk investments

Q4.14 Your trusted friend and neighbor, an experienced geologist, is putting together a group of investors to fund an exploratory gold mining venture. The venture could pay back 50 to 100 times the investment if successful. If

the mine is a bust, the entire investment is worthless. Your friend estimates the chance of success is only 20%. If you had the money, how much would you invest?

- ❍ Nothing
- ❍ One month's salary
- ❍ Three month's salary
- ❍ Six month's salary

Financial literacy

Q5.1 Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy

- ❍ More than today with the money in this account
- ❍ Exactly the same as today with the money in this account
- ❍ Less than today with the money in this account

Q5.3 Considering a long time period (for example, 10 or 20 years), which asset described below normally gives the highest return?

- ❍ Savings accounts
- ❍ Stocks
- ❍ Bonds

Q5.2 Do you think that the following statement is true or false? "Bonds are normally riskier than stocks."

- ❍ True
- ❍ False

Q5.4 Normally, which asset described below displays the highest fluctuations over time?

- ❍ Stocks
- ❍ Savings accounts
- ❍ Bonds

Q5.5 When an investor spreads his money among different assets, does the risk of losing a lot of money:

- ❍ Stay the same
- ❍ Decrease
- ❍ Increase

Q5.6 Do you think that the following statement is true or false? "If you were to invest $1,000 in a stock mutual fund, it would be possible to have less than $1,000 when you withdraw your money."

- ❍ True
- ❍ False

Q5.7 Do you think that the following statement is true or false? "A stock mutual fund combines the money of many investors to buy a variety of stocks."

- ❍ True
- ❍ False

Q5.8 Do you think that the following statement is true or false? "After age 70 1/2, you have to withdraw at least some money from your 401(k) plan or IRA."

- ❍ True
- ❍ False

Q5.9 Do you think that the following statement is true or false? “A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less.”

- ❍ True
- ❍ False

Q5.10 Suppose you have $100 in a savings account and the interest rate is 20% per year and you never withdraw money or interest payments. After 5 years, how much would you have in this account in total?

- ❍ Less than $200
- ❍ Exactly $200
- ❍ More than $200

Q5.11 Which of the following statements is correct?

- ❍ Once one invests in a mutual fund, one cannot withdraw the money in the first year
- ❍ Mutual funds can invest in several assets, for example, invest in both stocks and bonds
- ❍ Mutual funds pay a guaranteed rate of return which depends on their past performance
- ❍ None of them

Q5.12 This is an attention filter. Please select 'None of them'.

- ❍ Less than $500
- ❍ Exactly $500
- ❍ More than $500
- ❍ None of them

Q5.13 Which of the following statements is correct? If somebody buys a bond of firm B:

- ❍ He has lent money to firm B
- ❍ He owns a part of firm B
- ❍ He is liable for firm B’s debts
- ❍ None of them

Q5.14 Suppose you owe $3,000 on your credit card. You pay a minimum payment of $30 each month. At an annual percentage rate of 12% (or 1% per month), how many years would it take to eliminate your credit card debt if you made no additional new charges?

- ❍ Less than 5 years
- ❍ Between 5 and 10 years
- ❍ Between 10 and 15 years
- ❍ Never

Perfectionism (Evaluation concerns)

Q6.1 If I fail at work/school, I am a failure as a person

- ❍ Strongly disagree
- ❍ Somewhat disagree
- ❍ Neural
- ❍ Somewhat agree
- ❍ Strongly agree

Q6.2 If someone does a task at work/school better than me, then I feel like I failed at the whole task

- ❍ Strongly disagree
- ❍ Somewhat disagree
- ❍ Neural
- ❍ Somewhat agree
- ❍ Strongly agree

Q6.3 If I do not do well all the time, people will not respect me

- ❍ Strongly disagree
- ❍ Somewhat disagree
- ❍ Neural
- ❍ Somewhat agree
- ❍ Strongly agree

Q6.4 The fewer mistakes I make, the more people will like me

- ❍ Strongly agree
- ❍ Somewhat agree
- ❍ Neural
- ❍ Somewhat disagree
- ❍ Strongly disagree

Part 7 Perfectionism (Striving)

Q7.1 I set higher goals for myself than most people

- ❍ Strongly agree
- ❍ Somewhat agree
- ❍ Neural
- ❍ Somewhat disagree
- ❍ Strongly disagree

Q7.2 I have extremely high goals

- ❍ Strongly agree
- ❍ Somewhat agree
- ❍ Neural
- ❍ Somewhat disagree
- ❍ Strongly disagree

Q7.3 Other people seem to accept lower standards from themselves than I do

- ❍ Strongly agree
- ❍ Somewhat agree
- ❍ Neural
- ❍ Somewhat disagree
- ❍ Strongly disagree

Q7.4 I expect higher performance in my daily tasks than most people

- ❍ Strongly agree
- ❍ Somewhat agree
- ❍ Neural
- ❍ Somewhat disagree
- ❍ Strongly disagree

Appendix C

The questionnaire of paper 3

Research Title: Chronotype, risk and time preference, and financial behaviours

Participant information sheet (English version of questionnaire)

ERGO-number **26671**

Please read this information carefully before deciding to take part in this research.

What is the research about?

This research is going to how circadian typology (morningness or eveningness) affect financial behaviours, such incomplete credit card payment and stock market participation. Regarding the definitions of them, morningness, also named as 'early risers', are mentally and physically active during the morning hours while eveningness, also named as 'night owls', are more alert at night and prefer to sleep in. We draw on the definition of risk preference and time preference, which we expect are able to bridge circadian typology and financial behaviours.

What will happen to me if I take part?

Participation will fill one questionnaire. It may take you 10 to 15 minutes to complete, including approximately 28 questions. Please make sure that you have sufficient time to finish if you are willing to joining. Your participation is very important because you will be profoundly contributing to this research.

Screening and eligibility?

If you are a student in the universities and your age is +18 years old, you are eligible to take part in the research.

Will my participation be confidential and in safety?

There will be no risk in taking this survey. Your answers and personal information will be confidential. Your name and contact details will not be shown as it is not required to provide your name. Only the aggregate statistical data will be presented in this research, in terms of a paper in the future. Data and results will be stored properly according to the Data Protection Act and saved in a locked cabinet or encrypted file in a password-protected computer.

What happens if you change your mind?

You may withdraw your consent and participating in the study at any time. You will not be penalized for this.

Participants may wish to contact:

The researcher, Di Wang (dw2n13@soton.ac.uk).

- ❍ Yes, I am willing to joining this survey.
- ❍ No, I do not want to join

Circadian Preference (Morningness or Eveningness)

Please check the response for each item that best describes you.

1.1. Considering only your own "feeling best" rhythm, at what time would you get up if you were entirely free to plan your day?

5:00-6:30 a.m.

6:30-7:45 a.m.

7:45-9:45 a.m.

9:45-11:00 a.m.

11:00 a.m.- 12:00 (noon)

1.2. Considering your only "feeling best" rhythm, at what time would you go to bed if you were entirely free to plan your evening?

8:00-9:00 p.m.

9:00-10:15 p.m.

10:15 p.m.-12:30 a.m.

12:30-1:45 a.m.

1:45-3:00 a.m.

1.3. Assuming normal circumstance, how easy do you find getting up in the morning? (Check one.

Not at all easy

Slightly easy

Fairly easy

Very easy

1.4. How alert do you feel during the first half hour after having awakened in the morning? (Check one.)

Not at all alert

Slightly alert

Fairly alert

Very alert

1.5. During the first half hour after having awakened in the morning. How tired do you feel? (Check one.)

Very tired

Fairly tired

Fairly refreshed

Very refreshed

1.6. You have decided to engage in some physical exercise. A friend suggests that you do this one hour twice a week and the best time for him is 7:00-8:00 a.m. Bearing in mind nothing else but your own “feeling best" rhythm, how do you think you would perform?

Would be in good form

Would be in reasonable form

Would find it difficult

Would find it very difficult

1.7. At what time in the evening do you feel tired and, as a result, in need of sleep?

8:00-9:00 p.m.

9:00-10:15 p.m.

10:15 p.m.-12:30 a.m.

12:30-1:45 a.m.

1:45-3:00 a.m.

1.8. You wish to be at your peak performance for a test which you know is going to be mentally exhausting and lasting for two hours. You are entirely free to plan your day, and considering only your own "feeling best" rhythm, which one of the four testing times would you choose?

8:00-10:00 a.m.

11:00 a.m.-l:00 p.m.

3:00-5:00 p.m.

7:00-9:00 p.m.

1.9. One hears about "morning" and "evening" types of people. Which ONE of these types do you consider yourself to be?

Definitely a morning type

More a morning than an evening type

More an evening than a morning type

Definitely an evening type

1.10. When would you prefer to rise (provided you have a full day's work--8 hours) if you were totally free to arrange your time?

Before 6:30 a.m.

6:30-7:30 a.m.

7:30-8:30 a.m.

8:30 a.m. or later

1.11. If you always had to rise at 6:00 a.m., what do you think it would be like Very difficult and unpleasant?

Rather difficult and unpleasant

A little unpleasant but no great problem

Easy and not unpleasant

1.12. How long a time does it usually take before you "recover your senses" in the morning after rising from a night's sleep?

0-10 minutes

11-20 minutes

21-40 minutes

More than 40 minutes

1.13. Please indicate to what extent you are a morning or evening active individual

Pronounced morning active (morning alert and evening tired)

To some extent, morning active

To some extent, evening active

Pronounced evening active (morning tired and evening alert)

Demographic information

2.1 What is your age?

18-29

30-44

45-54

2.2 What is your gender?

Female

Male

2.3 Marital status:

Others

Married

2.4 Highest Level of Education Attained

Less than High School

High school graduate

Some college

Bachelor degree

Master degree

PhD

2.5 What is your monthly expenses in UK pounds?

Less than £500

£500 to < £750

£750 to

£1000 to

£1500 to

More than £2000

2.6 Generally speaking, would you say that most people can be trusted, or that you cannot be too careful in dealing with people?

Strongly disagree

Disagree

Somewhat disagree

Neither agree nor disagree

Somewhat agree

Agree

Strongly agree

2.7 Have you invested in the stock market?

No

Yes

2.8 How do you see yourself? Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? Please tick a choice on the scale, where the value 0 means 'not at all willing to take risks', and the value 10 means 'very willing to take risks'

0

1

2

3

4

5

6

7

8

9

10

2.9 How do you see yourself? Are you generally a person who is fully prepared to take financial risks or do you try to avoid taking financial risks? Please tick a choice on the scale, where the value 0 means 'not at all willing to take financial risks', and the value 10 means 'very willing to take financial risks'

0

1

2

3

4

5

6

7

8

9

10

2.10 Please indicate below the option that best describes your payments on credit cards.

I do not use credit cards for payments

Always pays off monthly

Generally pays off monthly

Occasionally pays off monthly

Seldom pays off, but tries to pay down

Generally pays minimum each month

Time preference

3.1 When you are driving a car, how likely is it that you are wearing your seatbelt?

Never

Sometimes

About half the time

Most of the time

Always

3.2 How often do you smoke cigarettes?

Never

Sometimes

About half the time

Most of the time

Always

3.3 How often do you consume alcoholic beverages?

Never

Sometimes

About half the time

Most of the time

Always

3.4 How often do you use nutrition labels to select the foods you buy?

Never

Sometimes

About half the time

Most of the time

Always

3.5 How often do you engage in strenuous physical exercise?

Never

Sometimes

About half the time

Most of the time

Always

3.6 How often have you engaged in unprotected sex during the last year?

Never

Sometimes

About half the time

Most of the time

Always

3.7 How often do you choose foods for the purpose of creating a diet that will reduce your chances of having a diet-related illness in the future?

Never

Sometimes

About half the time

Most of the time

Always

清晨型和夜晚型对个人经济偏好的影响（Chinese version）
道德伦理编号：26671

研究内容？
此项研究是用于解答是否早睡早起或晚睡晚起会对一个人的经济偏好产生显著影响。早睡早起的人，可定义为“清晨型”，通常精神和生理上在早晨处于峰值状态。而晚睡晚起的人，可定义为“夜晚型”，则在夜间更为清醒和兴奋并倾向于晚睡。经济偏好包括风险偏好，时间偏好，等等。这些偏好往往会影响一个人在经济或者金融领域中的决策。

我需要做什么？
您将在此调查问卷中回答 30 个问题，大概会占用您 10 分钟左右的时间。您的参与对我们的研究至关重要。

谁可以选择参与此次调查问卷？
此次调查问卷适用于在职，且已经有 3 到 8 年工作经验的朋友。

参加此次问卷调查是否安全？
是的，您完全不需要承担任何风险。您不需要透露任何您的个人信息，您的回答将是匿名，并且储存在由密码保护的电脑里。您的回答将和其他参与者的回答一起作为统计数据，被用于统计分析。

您也许想获得更多的信息？
您可以在任何时候联系此次问卷调查的研究员王迪，联系方式是
dw2n13@soton.ac.uk

非常感谢您的参与！

1. 生理节奏偏好（清晨型或者夜晚型）
请选择一个最能准确描述你的选项

如果你能夠完全自由地计划白天的时间，你希望大约在什么时间起床? [单选题] [必答题]
- ○ 早上 5 点至 6 点半
- ○ 早上 6 点半到 7 点 45 分
- ○ 早上 7 点 45 分到 9 点 45 分
- ○ 早上 9 点 45 分到 11 点
- ○ 早上 11 点到正午 12 点

2. 如果你能夠完全自由地计划夜晚，你希望大约在什么时间去睡觉? [单选题] [必答题]
- ○ 晚上 8 点至 9 点
- ○ 晚上 9 点到 10 点 15 分
- ○ 晚上 10 点 15 分到 12 点半
- ○ 凌晨 12 点半到 1 点 45 分
- ○ 凌晨 1 点 45 分到 3 点

3. 在一般情况下，在早上时，你有多容□ □ □？[单选题] [必答题]

○ 一点都不容易
○ 一般容易
○ 比较容易
○ 非常容易

4. 早上起床后的半小時內，你精神好吗? [单选题] [必答题]
○ 完全没有精神
○ 有一点精神
○ 一般精神
○ 非常有精神

5. 早上起床后的半小时内，你有多疲倦？ [单选题] [必答题]
○ 非常疲倦
○ 一般疲倦
○ 一般清醒
○ 非常清醒

6. 假设你决定要开始做运动，你的朋友建议你应该一周进行两次一小时的运动，而且在早上 7-8 点为最佳时间。请牢记你只需考虑自己的生□ 节奏，你认为你会表现得怎么样? [单选题] [必答题]
○ 很好的表现
○ 正常的表现
○ 会有困难
○ 会有非常大的困难

7. 在夜晚你大约到□ 么时候，你会感到疲倦，而且需要睡觉? [单选题] [必答题]
○ 晚上 8 点到 9 点
○ 晚上 9 点到 10 点 15 分
○ 晚上 10 点 15 分到 12 点 30 分
○ 凌晨 12 点 30 分到 1 点 45 分
○ 凌晨 1 点 45 分到 3 点

8. 假设你希望在一项会□ 你精神疲□ □ □ □ □ 续两个小時的测试中取得最佳表现时，如果你能完全自由地计划你的时间，且你仅需考虑你自己的生□ 节奏，你会选择以下哪段测试时间? [单选题] [必答题]
○ 早上 8 点到 10 点
○ 早上 11 点到下午 1 点
○ 下午 3 点到 5 点
○ 晚上 7 点到 9 点

9. 人可分为“清晨”型和“夜晚”型,你认为自己属于哪一类型? [单选题] [必答题]
○ 绝对的清晨型
○ 更倾向于清晨型
○ 更倾向于夜晚型
○ 绝对的夜晚型

10. 如果你一天需要工作 8 个小时，但是你可以自由选择在何时开始工作, 你会选择在什么时间起床? [单选题] [必答题]
- ○ 在早上六点半之前
- ○ 早上六点半到七点半
- ○ 早上七点半到八点半
- ○ 早上半点半或者更晚

11. 如果你需要在早上六点钟起床，你会怎么想？ [单选题] [必答题]
- ○ 非常困难并且不悦
- ○ 相当困难并且不悦
- ○ 有一点不悦，但是没有大的问题
- ○ 容易并且不会不悦

12. 经过一晚的睡眠，起来的时候，需要花多长时间恢复清醒的状态？ [单选题] [必答题]
- ○ 少于 10 分钟
- ○ 11 到 20 分钟
- ○ 21 到 40 分钟
- ○ 多于 40 分钟

13. 请指出你在多大程度上属于清晨型活跃或者夜晚型活跃？ [单选题] [必答题]
- ○ 显著的清晨型活跃（早晨清醒，夜晚低迷）
- ○ 在一定程度上的清晨型活跃
- ○ 在一定程度上的夜晚型活跃
- ○ 显著的夜晚型活跃（早晨低迷，夜晚清醒）

14. 您的年龄？ [单选题] [必答题]
- ○ 18-29 岁
- ○ 30-44 岁
- ○ 45-54 岁

15. 您的性别？ [单选题] [必答题]
- ○ 女
- ○ 男

16. 你的婚姻现状？ [单选题] [必答题]
- ○ 其他
- ○ 已婚

17. 您的受教育程度？ [单选题] [必答题]
- ○ 高中以下
- ○ 高中
- ○ 大专
- ○ 本科

○ 硕士研究生
○ 博士研究生

18. 您每月的工资收入？ [单选题] [必答题]
○ 3000 元以下
○ 3000 到 5000 元
○ 5000 到 7500 元
○ 7500 到 10000 元
○ 10000 到 20000 元
○ 20000 元以上

19. 总体而言，您是否认为自己是可以相信绝大多数人的？ [单选题] [必答题]
○ 完全不同意
○ 不同意
○ 一定程度上不同意
○ 介于同意与不同意之间
○ 一定程度上同意
○ 同意
○ 完全同意

20. 您是否已经参加过股票投资？ [单选题] [必答题]
○ 否
○ 是

21. 总体上来说，您是否认为自己是一个可以完全可以接受风险的人，或者是一个完全避免风险的人？请从 0 到 10 的量表中选择一个选项，0 表示完全没有意愿承担风险，10 表示非常有意愿去承担风险。 [单选题] [必答题]
○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

22. 总体上来说，您是否认为自己是一个完全可以接受金融方面风险的人，或者是一个完全避免金融方面风险的人？请从 0 到 10 的量表中选择一个选项，0 表示完全没有意愿承担金融风险，10 表示非常有意愿去承担金融风险。 [单选题] [必答题]
○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

23. 请从下列选项中选出最能描述你还款信用卡情况的一项？ [单选题] [必答题]
○ 我不使用信用卡
○ 按月，我都完全还清
○ 按月，我一般来说都完全还清
○ 按月，我偶尔会完全还清
○ 按月，我很少完全还清，但是会尝试去还清
○ 每月我只还清最低额度

24. 当您在驾车时，有多大的可能性您系着安全带？ [单选题] [必答题]
○ 从不 ○ 有时而已 ○ 大约一半 ○ 绝大多数 ○ 一直

25. 您是否经常抽烟？ [单选题] [必答题]
○ 从不 ○ 有时候 ○ 大约一半 ○ 绝大多数 ○ 一直

26. 你是否经常消费酒精饮品？ [单选题] [必答题]
○ 从不 ○ 有时候 ○ 大约一半 ○ 绝大多数 ○ 一直

27. 在超市购物，您是否经常通过看食物营养标签上的信息，来具体挑选食物？ [单选题] [必答题]
○ 从不 ○ 有时候 ○ 大约一半 ○ 绝大多数 ○ 一直

28. 您是否经常进行剧烈的体育运动？ [单选题] [必答题]
○ 从不 ○ 有时候 ○ 大约一半 ○ 绝大多数 ○ 一直

29. 在去年，您是否经常进行未做保护的性行为？ [单选题] [必答题]
○ 从不 ○ 有时候 ○ 大约一半 ○ 绝大多数 ○ 一直

30. 为了减少患与饮食有关的疾病的可能性，您是否经常以此来挑选具体的饮食？ [单选题] [必答题]
○ 从不 ○ 有时候 ○ 大约一半 ○ 绝大多数 ○ 一直

Robustness check

I changed the dichotomously measured morningness in the benchmark analysis to a continuum scale because based on the idea proposed by Chelminski et al. (1997) that using a continuum scale for morningness-eveningness could provide richer information regarding the hypothesized relationships. I also used a different single self-reported question, as proposed by Dohmen et al. (2011), to measure risk preference, and generate an all-around factor to predict risky behaviour. In addition, I added both risk and time preference measures in all settings of regressions and path analyses, as risk and time are intertwined. It would be problematic to isolate risk attitude when examining the effect of time preference on certain behaviours (Andreoni and Sprenger, 2012), as uncontrolled risk can create present-biased choices or behaviours. By changing the measurements of the interested variables, I intend to verify the robustness of the results.

The continuum form of morningness-eveningness (*Circadian rhythm*) ranges from 15 to 51, where a higher score indicates greater morning orientation. General risk preference is a single indicator with a higher score presenting a higher level of risk taking, ranging from 1 to 11.

I conducted a robustness check on hypotheses (H1, H2, H3, H4, H6), because these hypotheses were supported by the benchmark results. First, I tested the link between circadian rhythm and revolving credit card debt.

Table 4.11. The effect of circadian rhythm on likelihood of delinquent credit card payments in logistic regression.

Dependent variable: Delinquent credit card payment	Logistic regression			
Variables	Average marginal effect	SE	z-statistic	p-value
Main variables				
Circadian rhythm	-0.055***	0.016	-3.34	0.001
Control variables				
Age	0.022	0.226	0.10	0.922
Male	-0.141	0.225	-0.63	0.531
Married	0.218	0.256	0.85	0.395
Education	-0.120	0.210	-0.58	0.565
Monthly income	0.088	0.111	1.36	0.174
Time preference	-0.085**	0.040	-2.11	0.035
General risk preference	0.100	0.067	1.49	0.136
Log pseudolikelihood	-278.827			
Pseudo R2	0.045			
Number of observations	455			

Note: The dependent variable is delinquent credit card payments. This table reports the average marginal effect of logistic regression examining the effect of circadian rhythm on delinquent credit card payments. The sample is comprised of Chinese full-time employees who have been working for 3 to 8 years, randomly sampled from an online survey. *, **, and *** respectively indicate significance at 10% level (2-sided), 5% level, and 1% level. Pseudo R2 reports model fit.

The results recorded in Table 4.11 indicate that circadian rhythm is negatively associated with the possibility of delinquent credit card payments (b=-0.055, SE=0.016, z=-3.34, p<0.01), which supports Hypothesis 1.

Second, I tested whether time preference mediates the relationship between circadian rhythm and delinquent credit card debt. Table 4.12 conveys the results (bootstrapping coefficient of indirect effect=-0.107, bootstrapping SE=0.005, 95%C=[-0.023, -0.001]), which supports Hypothesis 2.

Table 4.12. The mediating effect of time preference on the relationship between circadian rhythm and delinquent credit card payments.

	Time preference			Delinquent credit card payments		
Variables	Coefficient	SE	t	Coefficient	SE	z
Constant	20.912***	1.051	19.890	2.716	1.165	2.331
Circadian rhythm	2.136***	0.375	5.701	-0.055***	0.017	-2.239
Age	0.557**	0.273	2.039	0.023	0.222	0.100
Male	-0.904***	0.272	-3.324	-0.141	0.225	-0.636
Married	-0.169	0.337	-0.500	0.218	0.257	0.848
Education	1.029***	0.293	3.511	-0.120	0.196	-0.837
Monthly income	-0.110	0.162	-0.682	0.089	0.106	0.838
General risk preference	0.1006	0.649	1.551	0.101	0.065	1.551
Time preference				-0.085**	0.038	-2.239
R2	0.167					
Pseudo R2				0.048		
Number of observations	455			455		

Mediator	Bootstrapping effect	Boot SE	95% CI (LL, UL)	
Time preference				
Indirect effect	-0.107	0.005	-0.023	-0.001

Note: Unstandardized regression coefficients are reported; bootstrap sample size=5,000. CI=confidence interval; LL=lower limit; UL= upper limit. * indicates p<0.1, ** indicates p<.05, and *** indicates p<0.01.

Third, I set out to verify whether income moderates the time preference-delinquent credit card debt relationship, and whether the indirect effect of circadian rhythm on delinquent credit debt payments through time perspective, is moderated by monthly income, such that an indirect effect exists for those whose income is at low to average level. Table 4.13 reports the corresponding results, which supports Hypothesis 3 (The coefficient of interaction item monthly income*time preference=0.065, SE=0.027, p<0.05) and Hypothesis 4 (Index of moderated mediation=0.008, Boot SE=0.004, 95%CI=[0.009, 0.018]).

Table 4.13. The conditional indirect effect of credit rhythm on delinquent credit card payments.

	Time preference			Delinquent credit card payments		
Variables	Coefficient	SE	t	Coefficient	SE	z
Constant	15.734***	1.508	10.428	8.469***	2.748	3.081
Age	0.600**	0.277	2.168	0.092	0.225	0.407
Male	-1.053***	0.281	-3.747	-0168	0.222	-0.756
Married	-0.429	0.326	-1.317	0.186	0.260	0716
Education	0.882***	0.276	3.195	-0.126	0.199	-0.663
Credit rhythm	0.127***	0.024	5.315	-0.057***	0.017	-3.372
General financial preference	0.165*	0.087	1.893	1.264*	0.665	1.899
Monthly income				-1.520**	0.695	-2.187
Time preference				-0.325***	0.110	-2.945
Monthly income*Time preference				0.065**	0.027	2.342
R2	0.165					
Pseudo R2				0.054		
Number of observations	455			455		

Moderator: Monthly income	Bootstrapping indirect effect	Boot SE	95% CI (LL, UL)	
Low (-1 SD from mean)	-0.023	0.009	-0.043	-0.008
Average (0 SD from mean)	-0.014	0.006	-0.027	-0.004
High (+1 SD from mean)	-0.005	0.006	-0.018	0.007

Index of moderated mediation				
Mediator	Index	Boot SE	95% CI (LL, UL)	
Time preference	0.008	0.004	0.009	0.018

Note: Unstandardized regression coefficients are reported; bootstrap sample size=5,000. CI=confidence interval; LL=low limit; UL= upper limit. * indicates p<0.1, ** indicates p<.05, and *** indicates p<0.01.

Finally, I examined whether financial risk preference mediates the relationship between circadian rhythm and the likelihood of investments in the stock market. Table 4.14 shows the results that support Hypothesis 6.

Table 4.14. The mediating effect of general risk preference on the relationship between circadian rhythm and stock market participation.

	General risk preference			Stock market participation		
Variables	Coefficient	SE	t	Coefficient	SE	z
Constant	4.544***	0.924	4.906	-5.454***	1.293	-4.218
Circadian rhythm	0.026*	0.013	1.958	0.543	0.006	0.018
Age	-0.244	0.171	-1.426	0.112	0.238	0.472
Male	0.732***	0.166	4.412	0.523**	0.238	2.196
Married	0.082	0.201	0.410	0.511**	0.260	1.964
Education	-0.212	0.143	-1.481	0.659***	0.218	3.030
Monthly income	0.389***	0.085	4.607	0.072	0.111	0.645
Time preference	0.065**	0.031	2.098	-0.020	0.041	-0.497
General risk preference				0.380***	0.068	5.601
R2	0.126					
Pseudo R2				0.125		
Number of observations	455			455		
Mediator	Bootstrapping		Boot SE	95% CI (LL, UL)		
General risk preference	effect					
Indirect effect	0.010		0.006	0.000	0.022	

Note: Unstandardized regression coefficients are reported; bootstrap sample size=10,000. CI=confidence interval; LL=low limit; UL= upper limit. * indicates p<0.1, ** indicates p<.05, and *** indicates p<0.01.

To summarize, after changing the measures of morningness-eveningness, and the measure of risk preference, the results are robust and support the findings in the benchmark analysis.

List of References

Abarbanel, B., Gainsbury, S. M., King, D., Hing, N., and Delfabbro, P. H. (2017) 'Gambling games on social platforms: How do advertisements for social casino games target young adults?' *Policy and Internet*, 9(2), pp. 184-209.

Accordino, D. B., Accordino, M. P., and Slaney, R. B. (2000) 'An investigation of perfectionism, mental health, achievement, and achievement motivation in adolescents', *Psychology in the Schools*, 37, pp. 535–545.

Achilles, G. M. and Georgianna, M. (2003) 'Individual differences in Morningness–eveningness and patterns of psychological functioning, social adaptation and family stress', *Dissertation Abstracts International: Section B: The Science and Engineering*, 64, pp. 6-B.

Adan, A. and Natale, V. (2002) 'Gender differences in morningness–eveningness preference', *Chronobiology international*, *19*(4), pp. 709-720.

Adan, A., Archer, S. N., Hidalgo, M. P., Di Milia, L., Natale, V., and Randler, C. (2012) 'Circadian typology: a comprehensive review', *Chronobiology international*, *29*(9), pp. 1153-1175.

Adan, A., Caci, H., and Prat, G. (2005) 'Reliability of the Spanish version of the Composite Scale of Morningness', *European Psychiatry*, *20*(7), pp. 503-509.

Agarwal, S. and Mazumder, B. (2013) 'Cognitive abilities and household financial decision-making', *American Economic Journal: Applied Economics*, 5(1), pp. 193–207.

Aiken, L. S., West, S. G. and Reno, R. R. (1991) *Multiple regression: Testing and interpreting interactions*. London: Sage.

Albert, S. M. and Duffy, J. (2012) 'Differences in risk aversion between young and older adults', *Neuroscience and neuroeconomics*, 1, pp. 3-9. doi: 10.2147/NAN. S27184.

Allgood, S. and Walstad, W. (2013) 'Financial literacy and credit card behaviors: A cross-sectional analysis by age', *Numeracy*, 6(2), pp. 1-26.

Allik, J. (2005) 'Personality dimensions across cultures', *Journal of Personality Disorders*, 19, pp. 212-232.

Almenberg, J. and Dreber, A. (2015) 'Gender, stock market participation and financial literacy', *Economics Letters*, *137*, pp. 140-142.

Al-Ubaydli, O., Jones, G. and Weel, J. (2016) 'Average player traits as predictors of cooperation in a repeated prisoner's dilemma', *Journal of Behavioral and Experimental Economics*, 64, pp. 50-60.

Andersen, S., Harrison, G. W., Lau, M. I. and Rutström, E. E. (2008) 'Eliciting risk and time preferences', *Econometrica*, 76(3), pp. 583-618.

Anderson, C. and Galinsky, A. D. (2006) 'Power, optimism, and risk-taking', *European journal of social psychology*, *36*(4), pp. 511-536.

Ando, A. and Modigliani, F. (1963) 'The 'life cycle' hypothesis of saving: Aggregate implication and tests', *American Economic Review*, 53(1), pp. 55-84.

Andreoni, J. and Sprenger, C. (2012) 'Risk preferences are not time preference', *The American Economic Review, 102*(7), pp. 3357-3376.

Andretic, R., Franken, P., and Tafti, M. (2008) 'Genetics of sleep', *Annual review of genetics, 42*, pp. 361-388.

Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., and Swinson, R. P. (1998) 'Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample', *Psychological Assessment*, 10(2), pp. 176-181.

Antúnez, J. M., Navarro, J. F., and Adan, A. (2014) 'Morningness–eveningness and personality characteristics of young healthy adults', *Personality and Individual Differences, 68*, pp. 136-142.

Apud, J. A., Mattay, V., Chen, J., Kolachana, B. S., Callicott, J. H., Rasetti, R., and Goldberg, T. E. (2007) 'Tolcapone improves cognition and cortical information processing in normal human subjects', *Neuropsychopharmacology*, 32(5), pp. 1011-1020.

Aspinwall, L. G., Hill, D. L., and Leaf, S. L. (2002) 'Prospects, pitfalls, and plans: A proactive perspective on social comparison activity', *European review of social psychology*, *12*(1), pp. 267-298.

Aspinwall, L. G., Sechrist, G. B., and Jones, P. R. (2005 'Expect the best and prepare for the worst: Anticipatory coping and preparations for Y2K', *Motivation and Emotion, 29*(4), pp. 353-384.

Attanasio, O. P., Banks, J., and Wakefield, M. (2004) '*Effectiveness of tax incentives to boost (retirement) saving: theoretical motivation and empirical evidence* (No. 04/33)', IFS Working Papers, Institute for Fiscal Studies (IFS).

Audia, P. G. and Greve, H. R. (2006) 'Less likely to fail: Low performance, firm size, and factory expansion in the shipbuilding industry', *Management science*, *52*(1), pp. 83-94.

Babbie, E. R. (2004) *The Practice of Social Research*. 13th ed. Belmont, CA: Wadsworth.

Bachmann, D. and Elfrink, J. (1996) 'Tracking the progress of e-mail versus snail mail', *Marketing Research*, 8, pp. 31–35.

Baehr, E. K., Revelle, W., and Eastman, C. I. (2000) 'Individual differences in the phase and amplitude of the human circadian temperature rhythm: with an emphasis on morningness–eveningness', *Journal of sleep research*, *9*(2), pp. 117-127.

Baetschmann, G., Staub, K. E., and Winkelmann, R. (2015) 'Consistent estimation of the fixed effects ordered logit model', *Journal of the Royal Statistical Society*. Series A, (Statistics in Society), 178(3), pp. 685–703.

Bailey, S. L. and Heitkemper, M. M. (1991) 'Morningness-eveningness and early-morning salivary cortisol levels', *Biological psychology*, *32*(2), pp. 181-192.

Baker, H. K., Filbeck, G., and Ricciardi, V. (2017) 'Chapter 1 Financial behaviour: An Overview' in Baker, H. K., Filbeck, G., and Ricciardi, V. (eds.). *Financial Behavior: Players, Services, Products, and Markets*. Oxford: Oxford University Press, pp. 3-22.

Balloch, A., Nicolae, A., and Philip, D. (2015) 'Stock market literacy, trust, and participation', *Review of Finance*, 19(5), pp. 1925–1963.

Bandura, A. (1977) 'Self-efficacy: toward a unifying theory of behavioural change', *Psychological Review*, 84, pp. 191–215.

Banks, J. and Oldfield, Z. (2007) 'Understanding pensions: Cognitive function, numerical ability and retirement saving', *Fiscal studies*, 28(2), pp. 143-170.

Barber, B. M. and Odean, T. (2001) 'Boys will be boys: Gender, overconfidence, and common stock investment', *The Quarterly Journal of Economics*, 116(1), pp. 261–292.

Barnhoorn, J. S., Haasnoot, E., Bocanegra, B. R., and van Steenbergen, H. (2015) 'QRTEngine: An easy solution for running online reaction time experiments using Qualtrics', *Behaviour research methods*, 47, pp. 918-929.

Baron, R. M. and Kenny, D. A. (1986) 'The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations', *Journal of Personality and Social Psychology*, 51(6), pp. 1173-1182.

Barr, M. S., Mullainathan, S., and Shafir, E. (2009) 'The case for behaviorally informed regulation', in Shafir, E. (eds) *Behavioral Foundations of Policy*. Princeton: Princeton University press, pp. 25-61.

Barsky, R. B., Juster, F. T., Kimball, M. S., and Shapiro, M. D. (1997) 'Preference parameters and behavioral heterogeneity: An experimental approach in the health and retirement study', *The Quarterly Journal of Economics*, *112*(2), pp. 537-579.

Bayer, P. J., Bernheim, B. D., and Scholz, J. K. (2009) 'The effects of financial education in the workplace: Evidence from a survey of employers', *Economic Inquiry*, *47*(4), pp. 605–624.

Bayer, R. C. and Renou, L. (2016) 'Logical omniscience at the laboratory', *Journal of Behavioural and Experimental Economics*, 64, pp. 41-49.

Behrman, J. R., Mitchell, O. S., Soo, C., and Bravo, D. (2010) '*Financial literacy, schooling, and wealth accumulation* (No. w16452)', National Bureau of Economic Research.

Benjamin, D. J., Chabris, C. F., Glaeser, E. L., Gudnason, V., Harris, T. B., Laibson, D. I., Launer, L. J., and Purcell, S. (2007) 'Genoeconomics', in Maxine, W., Vaupel, J. W., and Wachter, K. W. (eds). *Biosocial Surveys*. Washington: The National Academies Press, pp. 192-289.

Benito-Ostolaza, J. M., Hernández, P., and Sanchis-Llopis, J. A. (2016) 'Do individuals with higher cognitive ability play more strategically?' *Journal of Behavioral and Experimental Economics*, 64, pp. 5–11.

Benjamin, D. J., Brown, S. A., and Shapiro, J. M. (2013) 'Who is 'behavioral'? Cognitive ability and anomalous preferences', *Journal of the European Economic Association*, 11(6), pp. 1231-1255.

Benish, R. A. (1998) 'The ongoing challenge of providing investment education', *Compensation and Benefits Management*, 14(1), pp. 42-47.

Benzoni, L., Collin-Dufresne, P., and Goldstein, R. S. (2007) 'Portfolio choice over the life-cycle when the stock and labor markets are cointegrated', *The Journal of Finance*, 62(5), pp. 2123–2167.

Bernheim, D. and Rangel, A. (2004) 'Addiction and Cue-Triggered Decision Processes', *American Economic Review*, 94(5), pp. 1558-1590.

Bertocchi, G., Brunetti, M., and Torricelli, C. (2011) 'Marriage and other risky assets: A portfolio approach', *Journal of Banking & Finance*, 35(11), pp. 2902-2915.

Beshears, J., Choi, J., Laibson, D., and Madrian, B. C. (2008) 'The importance of default options for retirement saving outcomes: evidence from the United States', in Kay, S. and Sinha, T. (eds). *Lessons from Pension Reform in the Americas*. Oxford: Oxford University Press, pp. 59-87.

Bi, Y.X . (2012) 'On the death penalty for drug-related crime in China', *Human Rights and Drugs*, 2(1), pp. 29-44

Bieling, P. J., Israeli, A., Smith, J., and Antony, M. M. (2003) 'Making the grade: The behavioral consequences of perfectionism in the classroom', *Personality and Individual Differences*, 35(1), pp. 163-178.

Biemer, P. P. and Lyberg, L. E. (2003) *Introduction to Survey Quality*. Hoboken, NJ: John Wiley & Sons.

Biss, R. K. and Hasher, L. (2012) 'Happy as a lark: Morning-type younger and older adults are higher in positive affect' *Emotion*, *12*(3), pp. 437-441.

Blundell, R., Crawford, R., French, E., and Tetlow, G. (2016) 'Comparing retirement wealth trajectories on both sides of the pond' *Fiscal Studies*, 37(1), pp. 105-130.

Bode, S., He, A. H., Soon, C. S., Trampel, R., Turner, R., and Haynes, J. D. (2011) 'Tracking the unconscious generation of free decisions using uitra-high field fMRI', *PloS one*, 6(6), e21612.

Bodie, Z., Merton, R. C., and Samuelson, W. F. (1992) 'Labor supply flexibility and portfolio choice in a life cycle model', *Journal of Economic Dynamics and Control*, 16(3-4), pp. 427–449.

Bogan, V. (2008) 'Stock market participation and the internet', *Journal of Financial and Quantitative Analysis*, *43*(1), pp. 191-211.

Bogan, V. L. and Fertig, A. R. (2013) 'Portfolio choice and mental health', *Review of Finance*, 17(3), pp. 955–992.

Bollen, J., Mao, H., and Zeng, X. (2011) 'Twitter mood predicts the stock market', *Journal of Computational Science*, 2(1), pp. 1-8.

Borghans, L., Golsteyn, B., Heckman, J., and Meijers, H. (2009) 'Gender differences in risk aversion and ambiguity aversion', *Journal of the European Economic Association*, 7(2–3), pp. 649–658.

Bossaerts, P. and Murawski, C. (2015) 'From behavioural economics to neuroeconomics to decision neuroscience: the ascent of biology in research on human decision making', *Current Opinion in Behavioral Sciences*, 5, pp. 37-42.

Brand, M. and Altstötter-Gleich, C. (2008) 'Personality and decision-making in laboratory gambling tasks–Evidence for a relationship between deciding advantageously under risk conditions and perfectionism', *Personality and Individual Differences*, 45(3), pp. 226-231.

Brand, M., Heinze, K., Labudda, K., and Markowitsch, H. J. (2008) 'The role of strategies in deciding advantageously in ambiguous and risky situations', *Cognitive Processing*, *9*(3), pp. 159-173.

Becker, T. A., and Shabani, R. (2010) 'Outstanding debt and the household portfolio. The Review of Financial Studies, 23(7), 2900-2934.

Brocas, O. and Carrillo, J. (2008) 'The Brain as a Hierarchical Organization', *American Economic Review*, 98(4), pp. 1312–1346.

Brown, S. and Taylor, K. (2014) 'Household finances and the 'Big Five' personality traits', *Journal of Economic Psychology*, *45*, pp. 197-212.

Browne, M., Langham, E., Rawat, V., Greer, N., Li, E., Rose, J., Rockloff, M., Donaldson, P., Thorne, H., Goodwin, B., Bryden, G., and Best, T. (2016). Assessing Gambling-Related Harm in Victoria: A Public Health Perspective. Victorian Responsible Gambling Foundation.

Bryant, W. k. (ed.) (1990) *The economic organization of the households*. Cambridge: Cambridge University Press.

Bryman, A. and Bell, E. (eds) (2015) *Business research methods*. 4th edn. Oxford: Oxford University Press.

Bucciol, A. and Miniaci, R. (2011) 'Household portfolios and implicit risk preference', *Review of Economics and Statistics*, *93*(4), pp. 1235-1250.

Bugliari, D., Campbell, N., Chan, C., Hayden, O., Hurd, M., Main, R., and Clair, P. (2016). *Rand Hrs Data Documentation*, Version P. Available at: http://hrsonline.isr.umich.edu/modules/meta/rand/randhrsp/randhrs_P.pdf (Accessed: August 2016).

Burgess, A. M., Frost, R. O., and DiBartolo, P. M. (2016) 'Development and Validation of the Frost Multidimensional Perfectionism Scale–Brief', *Journal of Psychoeducational Assessment*, 34(7), pp. 620-633.

Burkill, S., Copas, A., Couper, M. P., Clifton, S., Prah, P., Datta, J., and Erens, B. (2016) 'Using the web to collect data on sensitive behaviours: a study looking at mode effects on the British National Survey of Sexual Attitudes and Lifestyles', *PLoS One*, 11(2), e0147983.

Buschkens, J., Graham, D., and Cottrell, D. (2010) 'Well-being under chronic stress: Is morningness an advantage?' *Stress Health*, 26(4), pp. 330-340.

Caci, H., Nadalet, L., Staccini, P., Myquel, M., and Boyer, P. (1999) 'Psychometric properties of the French version of the Composite Scale of Morningness in adults', *European Psychiatry*, *14*(5), pp. 284-290.

Cacioppo, J. T. and Hawkley, L. C. (2009) 'Perceived social isolation and cognition', *Trends in cognitive sciences*, 13(10), pp. 447-454.

Calem, P. S. and Mester, L. J. (1995) 'Consumer behavior and the stickiness of credit card interest rates', *The American Economic Review*, *85*(5), pp. 1327-1336.

Campbell, J. Y. (2006) 'Household finance', *The Journal of Finance*, 61(4), pp. 1553–1604.

Cameron, A. C. and Trivedi, P. K. (2010). *Microeconometrics using stata*. Revised edn. College Station, TX: Stata press.

Callegaro, M. and DiSogra, C. (2008) 'Computing response metrics for online panels', *Public opinion quarterly*, 72(5), pp. 1008-1032.

Carciofo, R., Du, F., Song, N., Qi, Y., and Zhang, K. (2012) 'Age-related chronotype differences in Chinese, and reliability assessment of a reduced version of the Chinese Morningness–Eveningness Questionnaire', *Sleep and Biological Rhythms, 10*(4), pp. 310-318.

Carducci, B. J. and Wong, A.S. (1998), 'Type A and risk taking in everyday money matters', *Journal of Business and Psychology*, 12(3), pp. 355-359.

Castrén, S., Kontto, J., Alho, H., and Salonen, A. H. (2018) 'The relationship between gambling expenditure, socio-demographics, health-related correlates and gambling behaviour–a crosssectional population-based survey in Finland', *Addiction*, 113(1), pp. 91-106. doi:10.1111/add.13929

Cavallera, G. M. and Giudici, S. (2008) 'Morningness and eveningness personality: A survey in literature from 1995 up till 2006', *Personality and Individual differences*, *44*(1), pp. 3-21.

Cesarini, D., Dawes, C. T., Johannesson, M., Lichtenstein, P., and Wallace, B. (2010) 'Genetic variation in preferences for giving and risk taking', *The Quarterly Journal of Economics*, 124(2), pp. 809-842.

Charness, G., Gneezy, U., and Imas, A. (2013) 'Experimental methods: Eliciting risk preferences', *Journal of Economic Behavior & Organization*, *87*, pp. 43-51.

Chatterjee, S., Finke, M. and Harness, N. (2011) 'The impact of self-efficacy on wealth accumulation and portfolio choice', *Applied Economics Letters*, 18(7), pp. 627–631.

Chelminski, I., Ferraro, F. R., Petros, T., and Plaud, J. J. (1997) 'Horne and Ostberg questionnaire: A score distribution in a large sample of young adults', *Personality and Individual differences*, *23*(4), pp. 647-652.

Chen, D., Cheng, C. Y., and Urpelainen, J. (2016) 'Support for renewable energy in China: A survey experiment with internet users', *Journal of Cleaner Production*, 112, pp. 3750-3758.

Chen, H. and Volpe, R. P. (1998) 'An analysis of personal financial literacy among college students', *Financial Services Review*, 7(2), pp. 107–128.

Chetty, R., Sándor, L., and Szeidl, A. (2017) 'The effect of housing on portfolio choice', *The Journal of Finance*, 72(3), pp. 1171-1212.

Chien, S., Campbell, N., Hayden, O., Hurd, M., Main, R., Mallett, J., and Rohwedder, S. (2015). Rand hrs data documentation, version N. Labor and Population Program: RAND center for the Study of Aging.

China Human Capital Report (2016). Available at: http://humancapital.cufe.edu.cn/en/Human_Capital_Index_Project/Project_2016/China_Human_Capital_Report.htm. (Accessed: 7 December 2017).

Christelis, D., Jappelli, T.,and Padula, M. (2010) 'Cognitive abilities and portfolio choice', *European Economic Review*, 54(1), pp. 18–38.

Cinan, S. and Doğan, A. (2013) 'Working memory, mental prospection, time orientation, and cognitive insight', *Journal of Individual Differences*, 34, pp. 159-169.

Clark, T. S. and Linzer, D. A. (2015) 'Should I use fixed or random effects?' *Political Science Research and Methods*, 3(02), pp. 399-408.

Coates, J. M., Gurnell, M., and Sarnyai, Z. (2010) 'From molecule to market: steroid hormones and financial risk-taking', *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, 365(1538), pp. 331-343.

Cobb-Clark, D. A., Kassenboehmer, S. C., and Sinning, M. G. (2016) 'Locus of control and saving', *Journal of Banking & Finance*, 73, pp. 113-130.

Cocco, J. F., Gomes, F. J., and Maenhout, P. J. (2005) 'Consumption and portfolio choice over the life cycle', *The Review of Financial Studies*, 18(2), pp. 491-533.

Conlin, A., Kyröläinen, P., Kaakinen, M., Järvelin, M.R., Perttunen, J. and Svento, R. (2015) 'Personality traits and stock market participation', *Journal of Empirical Finance*, 33, pp. 34-50.

Colquhoun, W. P. (1971). Circadian variations in mental efficiency (Circadian rhythms in human mental performance from waking day, round of clock and simulated shiftwork studies). In *Biological rhythms and human performance*. London and New York: Academic Press, pp. 39-107.

Colsher, P. and Wallace, R. (1991) 'Longitudinal application of cognitive function measures in a defined population of community-dwelling elders', *Annals of Epidemi*ology, 1(3), pp. 215–230.

Community Business. (2014) *China achieving gender parity and ranks top among 6 Asian markets*. Available at: http://www.communitybusiness.org/library/News/2014/20141028_GDBA2014_PressRelease_China.pdf (Accessed: 7 December 2017).

Consumer Financial Protection Bureau. (2015). Financial Well-Being: The Goal of Financial Education. Report, Iowa City, IA: Consumer Financial Protection Bureau. Available at: http://files.consumerfinance.gov/f/201501_cfpb_report_financial-well-being.pdf (Accessed: 7th July 2017).

Cooper, W. W., Kingyens, A. T., and Paradi, J. C. (2014) 'Two-stage financial risk tolerance assessment using data envelopment analysis', *European Journal of Operational Research*, *233*(1), pp. 273-280.

Couper, M. P. (2000) 'Web-based surveys: A review of issues and approaches', *Public Opinion Quarterly*, 64(4), pp. 464–494.

Couper, M. P. (2017) 'New Developments in Survey Data Collection', *Annual Review of Sociology*, 43, pp. 121-145

Cronbach, L. J. (1951) 'Coefficient alpha and the internal structure of tests', *Psychometrika*, 16(3), pp. 297–334.

Cronqvist, H. and Jiang, D. L. (2017) 'Chapter 3 Individual Investors', in Baker, H. K., Filbeck, G., and Ricciardi, V. (eds.). *Financial Behavior: Players, Services, Products, and Markets.* Oxford: Oxford University Press, pp. 45-56.

Crook, A. E., Beier, M. E., Cox, C. B., Kell, H. J., Hanks, A. R., and Motowidlo, S. J. (2011) 'Measuring relationships between personality, knowledge, and performance using single-response situational judgment tests', *International Journal of Selection and Assessment*, 19(4), pp. 363-373.

Cropper, M. L., Aydede, S. K.,and Portney, P. R. (1994) 'Preferences for life saving programs: how the public discounts time and age', *Journal of Risk and Uncertainty*, 8(3), pp. 243-265.

Cueva, C., Roberts, R. E., Spencer, T., Rani, N., Tempest, M., Tobler, P. N., and Rustichini, A. (2015) 'Cortisol and testosterone increase financial risk taking and may destabilize markets', *Scientific reports*, 5(11200), pp. 1-16.

Curtin, R., Presser, S., and Singer, E. (2000) 'The effects of response rate changes on the index of consumer sentiment', *Public Opinion Quarterly*, *64*(4), pp. 413-428.

Dallman, M. F., and Bhatnagar, S. (2010) 'Chronic Stress and Energy Balance: Role of the Hypothalamo-Pituitary-Adrenal Axis', in McEwen, B. (ed.) *Handbook of Physiology, Section7. The Endocrine System*. New York: Oxford University Press, pp. 179-210.

de Rada, V. D. and Domínguez-Álvarez, J. A. (2014) 'Response Quality of Self-Administered Questionnaires A Comparison Between Paper and Web Questionnaires', *Social Science Computer Review*, 32(2), pp. 256-269.

Di Milia, L. and Muller, H. (2012) 'Does impression management impact the relationship between morningness–eveningness and self-rated sleepiness?' *Personality and Individual Differences*, *52*(6), pp. 702-706.

Díaz-Morales, J. F. and Sánchez-Lopez, M. P. (2008) 'Morningness-eveningness and anxiety among adults: A matter of sex/gender?' *Personality and Individual Differences*, *44*(6), pp. 1391-1401.

Diaz-Serrano, L. and O'Neill, D. (2004) *The Relationship between Unemployment and Risk-Aversion*. IZA Discussion Paper No. 1214, IZA, Bonn.

Dickerson, A., Hole, A. R., and Munford, L. A. (2014) 'The relationship between well-being and commuting revisited: Does the choice of methodology matter?' *Regional Science and Urban Economics*, 49, pp. 321-329.

Dimmock, S. G., Kouwenberg, R., Mitchell, O. S., and Peijnenburg, K. (2016) 'Ambiguity aversion and household portfolio choice puzzles: empirical evidence', *Journal of Financial Economics*, 119(3), pp. 559-577.

Dittrich, M. and Leipold, K. (2014) 'Gender differences in time preferences', *Economics Letters*, *122*(3), pp. 413-415.

Dohmen, T., Falk, A., Huffman, D., and Sunde, U. (2010) 'Are risk aversion and impatience related to cognitive ability?', *The American Economic Review*, 100(3), pp. 1238–1260.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., and Wagner, G. G. (2011) 'Individual risk attitudes: Measurement, determinants, and behavioral consequences', *Journal of the European Economic Association*, *9*(3), pp. 522-550.

Donkers, B., Melenberg, B., and Van Soest, A. (2001) 'Estimating risk attitudes using lotteries: A large sample approach', *Journal of Risk and Uncertainty*, 22(2), pp. 165–195.

Donnelly, G., Iyer, R., and Howell, R. T. (2012) 'The Big Five personality traits, material values, and financial well-being of self-described money managers', *Journal of Economic Psychology*, 33(6), pp. 1129-1142.

Drever, A. I., Odders-White, E., Kalish, C. W., Else-Quest, N. M., Hoagland, E. M., and Nelms, E. N. (2015) 'Foundations of financial well-being: Insights into the role of executive function, financial socialization, and experience-based learning in childhood and youth', *Journal of Consumer Affairs*, *49*(1), pp. 13-38.

Duffy, J. F., Dijk, D. J., Hall, E. F., and Czeisler, C. A. (1999) 'Relationship of endogenous circadian melatonin and temperature rhythms to self-reported preference for morning or

evening activity in young and older people', *Journal of Investigating Medicine*, 47, pp.141–150.

Dunbar, G., Boeijinga, P. H., Demazieres, A., Cisterni, C., Kuchibhatla, R., Wesnes, K., and Luthringer, R. (2007) 'Effects of TC-1734 (AZD3480), a selective neuronal nicotinic receptor agonist, on cognitive performance and the EEG of young healthy male volunteers', *Psychopharmacology*, 191(4), pp. 919-929.

Dunkley, D. M., Zuroff, D. C., and Blankstein, K. R. (2003) 'Self-critical perfectionism and daily affect: Dispositional and situational influences on stress and coping', *Journal of Personality and Social Psychology*, 84(1), pp. 234–252.

Eckel, C. C. and Grossman, P. J. (2008) 'Men, Women and Risk Aversion: Experimental Evidence', in Plott, C. and Smith, V. (eds) *Handbook of experimental economics results, Volume 1, ed*. New York: Elsevier, pp. 1061–1073.

Eckel, C., Johnson, C., and Montmarquette, C. (2005) 'Saving decisions of the working poor: Short-and long-term horizons', in Jeffrey, P. C., Glenn, W. H., and John, A. List.(eds) *Field experiments in economics*. Greenwich, CT: Emerald Group Publishing Limited, pp. 219-260.

Edwards, R. D. (2008) 'Health risk and portfolio choice', *Journal of Business and Economic Statistics*, 26(4), pp. 472–485.

Edwards, P. J, Roberts, I. G, and Clarke, M. J. (2009) 'Methods to increase response rates to postal questionnaires', *Cochrane Database Systematic Review*, MR000008. doi: 10.1002/14651858. MR000008.pub3.

Eekhoudt, L., Gollier, C., and Schlesinger, H. (1996) 'Changes in Background Risk and Risk Taking Behavior', *Econometrica*, 64, pp. 683-689.

Elliehausen, G., Christopher, L. E., and Staten, M. E. (2007) 'The impact of credit counseling on subsequent borrower behavior', *Journal of Consumer Affairs*, *41*(1), pp. 1-28.

Elton, E. J. and Gruber, M. J. (1977) 'Risk reduction and portfolio size: An analytical solution', *The Journal of Business*, 50(4), pp. 415–437.

Estrada-Mejia, C., de Vries, M., and Zeelenberg, M. (2016) 'Numeracy and wealth', *Journal of Economic Psychology*, 54, pp. 53-63.

Evans, D. A., Beckett, L. A., Albert, M. S., Hebert, L. E., Scherr, P. A., Funkenstein, H. H., and Taylor, J. O. (1993) 'Level of education and change in cognitive function in a community population of older persons', *Annals of Epidemiology*, 3(1), pp. 71–77.

Fagereng, A., Gottlieb, C., and Guiso, L. (2017) 'Asset Market Participation and Portfolio Choice over the Life Cycle', *The Journal of Finance*, 72(2), pp. 705-750.

Favilukis, J., Ludvigson, S. C., and Van Nieuwerburgh, S. (2017) 'The macroeconomic effects of housing wealth, housing finance, and limited risk sharing in general equilibrium', *Journal of Political Economy*, 125(1), pp. 140-223.

Fehr, E. (2002) 'Behavioural science: The economics of impatience', *Nature*, *415*(6869), pp. 269-272.

Ferguson, C. J. (2009) 'Is psychological research really as good as medical research? Effect size comparisons between psychology and medicine', *Review of General Psychology*, *13*(2), 130-136. doi: 10.1037/a0015103.

Fernandes, D., Lynch Jr, J. G., and Netemeyer, R. G. (2014) 'Financial literacy, financial education, and downstream financial behaviors', *Management Science*, 60(8), pp. 1861-1883.

Filbeck, G., Hatfield, P., and Horvath, P. (2005) 'Risk aversion and personality type', *The Journal of Behavioral Finance*, *6*(4), pp. 170-180.

Finke, M. S. and Huston, S. J. (2013) 'Time preference and the importance of saving for retirement', *Journal of Economic Behavior & Organization*, 89, pp. 23-34.

Fiorillo, D., Lavadera, G. L., and Nappo, N. (2017) 'Social participation and self-rated psychological health: A longitudinal study on BHPS', *SSM-Population Health*, 3, pp. 266–274.

Fleig, D. and Randler, C. (2009) 'Association between chronotype and diet in adolescents based on food logs', *Eating behaviors*, *10*(2), pp. 115-118.

Flett, G. L. and Hewitt, P. L. (eds) (2002) *Perfectionism: Theory, research, and treatment*. Washington, DC: American Psychological Association.

Flower, D. J., Irvine, D., and Folkard, S. (2003) 'Perception and predictability of travel fatigue after long-haul flights: a retrospective study', *Aviation, space, and environmental medicine*, *74*(2), pp. 173-179.

Foldes, L. (2000) 'Valuation and martingale properties of shadow prices: An exposition', *Journal of Economic Dynamics & Control*, 24(11), pp. 1641–1701.

Forbes, J. and Kara, S. M. (2010) 'Confidence mediates how investment knowledge influences investing self-efficacy', *Journal of economic psychology*, *31*(3), pp. 435-443.

Franken, P. and Dijk, D. J. (2009) 'Circadian clock genes and sleep homeostasis', *European Journal of Neuroscience*, *29*(9), pp. 1820-1829.

Freedman, D. A. (ed.) (2009). *Statistical models: theory and practice*. Cambridge: Cambridge university press.

Fritzsche, D. and Oz, E. (2007) 'Personal values' influence on the ethical dimension of decision making', *Journal of Business Ethics*, 75(4), pp. 335-343.

Frost, R. O., Heimberg, R. G., Holt, C. S., Mattia, J. I., and Neubauer, A. L. (1993) 'A comparison of two measures of perfectionism', *Personality and Individual Differences*, 14(1), pp. 119-126.

Frost, R. O., Marten, P., Lahart, C., and Rosenblate, R. (1990) 'The dimensions of perfectionism', *Cognitive therapy and research*, 14(5), pp. 449-468.

Fudenburg, D. and Levine, D.K. (2006) 'A dual-self model of impulse control', *American Economic Review*, 96 (5), pp. 1449–1476.

Gafni, A., and Torrance, G. W. (1984) 'Risk attitude and time preference in health', *Management Science*, *30*(4), pp. 440-451.

Gardiner, J. C., Luo, Z., and Roman, L. A. (2009) 'Fixed effects, random effects and GEE: What are the differences?' *Statistics in Medicine*, 28(2), pp. 221–239.

Garman, E.T. and Forgue, R.E. (2011) *Personal finance*. 12th edn. Boston, NY: Houghton Mifflin Company.

Gathergood, J. (2012). 'Self-control, financial literacy and consumer over-indebtedness', *Journal of Economic Psychology*, *33*(3), pp. 590-602.

Gau, S. F., Soong, W. T., Lee, W. Y., and Chiu, Y. N. (1998) 'Reliability and validity of the Chinese version of the morningness/eveningness scale', *Taiwanese Journal of Psychiatry*, 12(2), pp. 98-109.

Gerardi, K., Goette, L., and Meier, S. (2010) Financial literacy and subprime mortgage delinquency: Evidence from a survey matched to administrative data. Working paper no. 2010-10. Federal. Reserve Bank Atlanta.

Gerardi, K., Goette, L., and Meier, S. (2013) 'Numerical ability predicts mortgage default', *Proceedings of the National Academy of Sciences*, 110(28), pp. 11267-11271.

Gilliam, J., Chatterjee, S., and Grable, J. E. (2010) 'Measuring the perception of financial risk tolerance: A tale of two measures', *Journal of Financial Counselling and Planning*, 21(2), pp. 30-43.

Goetzmann, W. N. and Kumar, A. (2008) 'Equity portfolio diversification', *Review of Finance*, 12, 433-463.

Goldstein, D., Hahn, C. S., Hasher, L., Wiprzycka, U. J., and Zelazo, P. D. (2007) 'Time of day, intellectual performance, and behavioral problems in Morning versus Evening type adolescents: Is there a synchrony effect?' *Personality and individual Differences*, *42*(3), pp. 431-440.

Gollier, C. (2000) 'What does the classical theory have to say about portfolio choice?' in Guiso, L., Haliassos, M., and Jappelli, T (eds). *Household Portfolios*. Cambridge, MA: MIT Press.

Gomes, F. J., Michaelides, A., and Polkovnichenko, V. (2005) Wealth accumulation and portfolio choice with taxable and tax-deferred accounts (No. 4852). Working paper, Centre for Economic Policy Research.

Gorodnichenko, Y. and Roland, G. (2017) 'Culture, institutions and the wealth of nations', *Review of Economics and Statistics*, 99, 402-416.

Grable, J. and Lytton, R. H. (1999) 'Financial risk tolerance revisited: the development of a risk assessment instrument', *Financial services review*, 8(3), pp. 163-181.

Grable, J. E. (2000) 'Financial risk tolerance and additional factors that affect risk taking in everyday money matters', *Journal of Business and Psychology*, 14(4), pp. 625-630.

Grable, J. E. and Lytton, R. H. (2003) 'The development of a risk assessment instrument: A follow-up study', *Financial services review*, 12(3), pp. 257-274.

Grable, J. E. and Roszkowski, M. J. (2008) 'The influence of mood on the willingness to take financial risks', *Journal of Risk Research*, *11*(7), pp. 905-923.

Groves, R.M. and Peytcheva, E. (2008) 'The impact of nonresponse rates on nonresponse bias', *Public Opinion Quarterly*, 72(2), pp. 167−189. doi:10.1093/ poq/nfn011.

Gravetter, F.J and Forzano, L.B. (eds) (2011). *Research Methods for the Behavioural Sciences.* 3rd edn. Wadsworth: Cengage Learning, p.141-146.

Grebitus, C., Steiner, B., and Veeman, M. (2012) 'Personal values and decision-making: evidence from Environmental footprint labeling in Canada', *American Journal of Agricultural Economics*, 95(2), pp. 397-403.

Griefahn, B. and Robens, S. (2008) 'The cortisol awakening response: a pilot study on the effects of shift work, morningness and sleep duration', *Psychoneuroendocrinology*, *33*(7), pp. 981-988.

Grinblatt, M., Keloharju, M., and Linnainmaa, J. (2011) 'IQ and stock market participation', *The Journal of Finance*, 66(6), pp. 2121–2164.

Grubb, M. A., Tymula, A., Gilaie-Dotan, S., Glimcher, P. W., and Levy, I. (2016) 'Neuroanatomy accounts for age-related changes in risk preferences', *Nature communications*, *7*, 13822.

Grzegorek, J. L., Slaney, R. B., Franze, S., and Rice, K. G. (2004) 'Self-criticism, dependency, self-esteem, and grade point average satisfaction among clusters of perfectionists and nonperfectionists', *Journal of Counseling Psychology*, 51, pp. 192–200.

Guiso, L. and Jappelli, T. (2005) 'Awareness and stock market participation', *Review of Finance*, *9*(4), pp. 537-567.

Guiso, L. and Paiella, M. (2008) 'Risk aversion, wealth, and background risk', *Journal of the European Economic association*, *6*(6), pp. 1109-1150.

Guiso, L. and Paiella, M. (2005) The Role of Risk Aversion in Predicting Individual Behavior. Bank of Italy Economic Working Paper No. 546.

Guiso, L. and Paiella, M. (2006) 'The Role of Risk Aversion in Predicting Individual Behavior', in Chiappori, P. and Gollier, C (eds) *Insurance: Theoretical Analysis and Policy Implications*. Boston, MA: MIT Press, pp. 213–249.

Guiso, L. and Jappelli, T. (2008) 'Financial Literacy and Portfolio Diversification', CSEF Working Paper No. 212.

Guiso, L., Jappelli, T., and Terlizzese, D. (1996) 'Income risk, borrowing constraints, and portfolio choice', *The American Economic Review*, *86*(1), pp. 158–172.

Guiso, L., Sapienza, P., and Zingales, L. (2008) 'Trusting the stock market', *The Journal of Finance*, *63*(6), pp. 2557-2600.

Gustman, A. L. and Steinmeier, T. L. (2015) 'Effects of social security policies on benefit claiming, retirement and saving', *Journal of Public Economics*, 129, pp. 51-62.

Guven, C. and Hoxha, I. (2015) 'Rain or shine: Happiness and risk-taking', *The Quarterly Review of Economics and Finance*, 57, pp. 1-10.

Halek, M. and Eisenhauer, J. G. (2001) 'Demography of risk aversion', *Journal of Risk and Insurance*, 68, 1-24.

Hamachek, D. E. (1978) 'Psychodynamics of normal and neurotic perfectionism', *Psychology*, 15, pp. 27-33.

Hanna, S. D. and Chen, P. (1997) 'Subjective and objective risk tolerance. Implications for optimal portfolios', *Financial Counselling and Planning*, 8, pp. 17–26.

Hardisty, D. J. and Pfeffer, J. (2016) 'Intertemporal uncertainty avoidance: When the future is uncertain, people prefer the present, and when the present is uncertain, people prefer the future', *Management Science*, 63(2), pp. 519-527.

Hayes, A. F. (ed.) (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York: Guilford Press.

Hayes, A. F. (2015) 'An index and test of linear moderated mediation', *Multivariate Behavioral Research, 50*(1), pp. 1-22.

Hayes, A. F., Preacher, K. J., and Myers, T. A. (2011) 'Mediation and the estimation of indirect effects in political communication research', *Sourcebook for political communication research: Methods, measures, and analytical techniques, 23*, pp. 434-465.

Hays, R. D., Liu, H., and Kapteyn, A. (2015) 'Use of Internet panels to conduct surveys', *Behavior research methods*, *47*(3), pp. 685-690.

Hazembuller, A., Lombardi, B. J., and Hogarth, J. M. (2007) 'Unlocking the risk-based pricing puzzle: Five keys to cutting credit card costs', *Consumer Interests Annual*, *53*, pp. 73-84.

Headey, B. and Wooden, M. (2004) 'The Effects of Wealth and Income on Subjective Well-Being and Ill-Being', *Economic record*, 80, pp. 24-33.

Heaton, J. and Lucas, D. (2000) 'Portfolio choice and asset prices: The importance of entrepreneurial risk', *The Journal of Finance*, *55*(3), pp. 1163–1198.

Heaton, J. and Lucas, D. (1997) 'Savings behavior and portfolio choice: evidence from the tax data', Unpublished working paper, Northwestern University.

Heckman, J. J. (1979) 'Sample selection bias as a specification error', *Econometrica*, 47, pp. 153 - 161.

Heidhues, P. and Koszegi, B. (2010) 'Exploiting naivete about self-control in the credit market' *The American Economic Review*, *100*(5), pp. 2279-2303.

Hermann, H., Trachsel, M., and Biller-Andorno, N. (2015) 'Physicians' personal values in determining medical decision-making capacity: a survey study', *Journal of medical ethics*, 41, pp. 739-744.

Hewitt, P. L. and Flett, G. L. (1991) 'Perfectionism in the self and social contexts: Conceptualization, assessment, and association with psychopathology', *Journal of Personality and Social Psychology*, 60 (3), pp. 456-470.

Hewitt, P. L., Mittelstaedt, W., and Wollert, R. (1989) 'Validation of a measure of perfectionism', *Journal of Personality Assessment*, 53(1), pp. 133-144.

Hickman, K., Hunter, H., Byrd, J., Beck, J., and Terpening, W. (2001) 'Life cycle investing, holding periods, and risk', *Journal of Portfolio Management*, 27, pp. 101–119.

Hill, R.W., Huelsman, T. J., and Araujo, G. (2010) 'Perfectionistic concerns suppress associations between perfectionistic strivings and positive life outcomes', *Personality and Individual Differences*, 48(5), pp. 584-589.

Hinton, P. R., Brownlow, C., McMurray, I., and Cozens, B. (eds) (2014). *SPSS Explained*. 2nd edn. East Sussex, England: Routledge Inc.

Hirshleifer, D. (2015) 'Behavioral finance', *Annual Review of Financial Economics, 7*, pp. 133-159.

Hofstede, G. (1980). 'Motivation, leadership, and organization: do American theories apply abroad?' *Organizational dynamics*, 9(1), pp. 42-63.

Hofstede, G. (ed.) (2003). *Culture's consequences: Comparing values, behaviours, institutions and organizations across nations*. Sage publications.

Holbrook, A., Krosnick, J. A., and Pfent, A. (2007) 'The causes and consequences of response rates in surveys by the news media and government contractor survey research firms', in Lepkowski, J., Harris-Kojetin, B., Lavrakas, P. J., Tucker, C., de Leeuw, E., Link, M., Brick, M., Japec, L., and Sangster, R. N. (eds) *Advances in Telephone Survey Methodology*. New York: Wiley, pp. 499-528.

Holt, C. A. and Laury, S. H. (2002) 'Risk Aversion and Incentive Effects', *American Economic Review*, 92, pp. 1644–1655.

Hong, H., Kubik, J. D., and Stein, J. C. (2004) 'Social interaction and stock-market participation', *The journal of finance*, *59*(1), pp. 137-163.

Horne, J. A. and Ostberg, O. (1976) 'A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms', *International journal of chronobiology*, *4*(2), pp. 97-110.

Hsiao, C. (2007) 'Panel data analysis-advantages and challenges', *Test*, 16, pp. 1–22.

Hsiao, C., Mountain, D. C., and Ho-Illman, K. (1995) 'Bayesian integration of end-use metering and conditional demand analysis', *Journal of Business & Economic Statistics*, 13, pp. 315–326.

Hur, Y. M. (2007) 'Stability of genetic influence on morningnesseveningness: A cross-sectional examination of South Korean twins from preadolescence to young adulthood', *Journal of Sleep Research*, 16(1), PP. 17–23.

Hurd, M. D. (2002) 'Portfolio holdings of the elderly', In Guiso, L., Haliassos, M., and Jappelli, T. (Eds.) *Household Portfolios*. Cambridge, MA: MIT Press, pp. 431–472.

International Monetary Fund. (2017). World Economic Outlook Database. Available at http://www.imf.org/external/pubs/ft/weo/2017/01/weodata/weorept.aspx?sy=2015&ey=2022&scsm=1&ssd=1&sort=country&ds=.&br=1&c=924&s=NGDPD%2CNGDPDPC%2CPPPGDP%2CPPPPC&grp=0&a=&pr.x=75&pr.y=16. (Accessed: 7 December 2017).

Internet World Stats. (2017). Top 20 Countries with highest number of Internet users. Available at http://www.internetworldstats.com/top20.htm. (Accessed: 7 December 2017).

Jagannathan, R. and Ma, T. (2003) 'Risk reduction in large portfolios: Why imposing the wrong constraints helps', *The Journal of Finance*, 58(4), PP. 1651–1684.

JAMA. (2013) Available at: http://Jama.Jamanetwork.Com/Public/Instructionsforauthors.Aspx. American Medical Association.

Jappelli, T. and Padula, M. (2013) 'Investment in financial literacy and saving decisions', *Journal of Banking and Finance*, 37(8), pp. 2779–2792.

Jianakoplos, N. A. and Bernasek, A. (1998) 'Are women more risk averse?' *Economic inquiry*, 36(4), pp. 620-630.

Johnson, J. S. (2016) 'Improving online panel data usage in sales research', *Journal of Personal Selling & Sales Management*, *36*(1), pp. 74-85.

Josef, A. K., Richter, D., Samanez-Larkin, G. R., Wagner, G. G., Hertwig, R., and Mata, R. (2016) 'Stability and change in risk-taking propensity across the adult life span', *Journal of personality and social psychology*, 111(3), pp. 430-450.

Juster, F. T. and Suzman, R. (1995) 'An overview of the Health and Retirement Study', *Journal of Human Resources*, 30, S7-S56.

Kahneman, D. and Tversky, A. (1979) 'Prospect theory: An analysis of decision under risk', *Econometrica: Journal of the econometric society*, 47, pp. 263-291.

Kandasamy, N., Hardy, B., Page, L., Schaffner, M., Graggaber, J., Powlson, A. S., and Coates, J. (2014) 'Cortisol shifts financial risk preferences', *Proceedings of the National Academy of Sciences*, 111(9), pp. 3608-3613.

Katzenberg, D., Young, T., Finn, L., Lin, L., King, D. P., and Takahashi, J. S. (1998) 'A CLOCK polymorphism associated with human diurnal preference', *Sleep*, 21(6), pp. 569–576.

Keck, S., Diecidue, E., and Budescu, D. V. (2014) 'Group decisions under ambiguity: Convergence to neutrality', *Journal of Economic Behavior & Organization*, *103*, pp. 60-71.

Keeter, S., Kennedy, C., Dimock, M., Best, J., and Craighill, P. (2006) 'Gauging the impact of growing nonresponse on estimates from a national RDD telephone survey', *Public opinion quarterly*, 70, pp. 759-779.

Kerkhof, G. A. and Van Dongen, H. P. (1996) 'Morning-type and evening-type individuals differ in the phase position of their endogenous circadian oscillator', *Neuroscience letters*, *218*(3), pp. 153-156.

Killgore, W. D. (2007) 'Effects of sleep deprivation and morningness-eveningness traits on risk-taking', *Psychological reports*, 100(2), pp. 613-626.

Kim, H. and DeVaney, S. A. (2001) 'The determinants of outstanding balances among credit card revolvers', *Journal of Financial Counseling and Planning*, *12*(1), 67-78.

Kim, S. J., Lee, Y. J., Kim, H., Cho, I. H., Lee, J. Y., and Cho, S. J. (2010) 'Age as a moderator of the association between depressive symptoms and morningness–eveningness', *Journal of psychosomatic research*, *68*(2), pp. 159-164.

King, M. A. and Leape, J. I. (1998) 'Wealth and portfolio composition: Theory and evidence', *Journal of Public Economics*, 69, pp. 155–193.

Kirby, E. G. and Kirby, S. L. (2006) 'Improving task performance: The relationship between morningness and proactive thinking', *Journal of Applied Social Psychology*, *36*(11), pp. 2715-2729.

Kirby, E. G., Kirby, S. L., and Lewis, M. A. (2002) 'A study of the effectiveness of training proactive thinking', *Journal of Applied Social Psychology*, *32*(7), pp. 1538-1549.

Kirchler, E., Hoelzl, E., and Kamleitner, B. (2008) 'Spending and credit use in the private household', *Journal of Socio-Economics*, 37, pp. 519–532.

Kiss, H. J., Rodriguez-Lara, I., and Rosa-García, A. (2016). Think twice before running! Bank runs and cognitive abilities. *Journal of Behavioral and Experimental Economics*, 64, pp. 12–19.

Knüpfer, S., Rantapuska, E., and Sarvimäki, M. (2017) 'Formative experiences and portfolio choice: Evidence from the Finnish great depression', *The Journal of Finance*, 72(1), pp. 133-166.

Koenker, R. and Bassett, G. (1978) 'Regression quantiles', *Econometrica*, 46, pp. 33–50.

Koivula, N., Hassmén, P., and Fallby, J. (2002) 'Self-esteem and perfectionism in elite athletes: effects on competitive anxiety and self-confidence', *Personality and individual differences*, 32(5), pp. 865-875.

Korniotis, G. and Kumar, A. (2005) Does investment skill decline due to cognitive aging or improve with experience? Working paper, University of Notre Dame.

Kraus, M.W., Piff, P. K., and Keltner, D. (2009) 'Social class, sense of control, and social explanation', *Journal of personality and social psychology*, 97(6), p. 992-1004.

Kreuter, F., Presser, S., and Tourangeau, R. (2008) 'Social desirability bias in CATI, IVR, and web surveys: The effects of mode and question sensitivity', *Public Opinion Quarterly*, 72(5), pp. 847-865.

Krueger, N. and Dickson, P. R. (1994) 'How believing in ourselves increases risk taking: Perceived self-efficacy and opportunity recognition', *Decision Sciences*, *25*(3), pp. 385-400.

Kruger, P. S. (2011) 'Wellbeing—the five essential elements', *Applied Research in Quality of Life*, *6*(3), pp. 325-328.

Krusell, P. and Smith, A. A. (1997) 'Income and wealth heterogeneity, portfolio choice, and equilibrium asset returns', *Macroeconomic Dynamics*, 1(02), pp. 387–422.

Kudielka, B. M., Federenko, I. S., Hellhammer, D. H., and Wüst, S. (2006) 'Morningness and eveningness: the free cortisol rise after awakening in "early birds" and "night owls"', *Biological psychology*, 72(2), pp. 141-146.

Kuhnen, C. M. and Knutson, B. (2011) 'The influence of affect on beliefs, preferences, and financial decisions', *Journal of Financial and Quantitative Analysis*, *46*(3), pp. 605-626.

Kuhnen, C. M. and Miu, A. C. (2017) 'Socioeconomic status and learning from financial information', *Journal of Financial Economics*, 124(2), pp. 349-372.

Kurnianingsih, Y. A., Sim, S. K., Chee, M. W., and Mullette-Gillman, O. D. A. (2015) 'Aging and loss decision making: increased risk aversion and decreased use of maximizing information, with correlated rationality and value maximization', *Frontiers in human neuroscience*, 9, pp. 280. doi: 10.3389/fnhum.2015. 00280.

Laibson, D. (1997) 'Golden eggs and hyperbolic discounting', *The Quarterly Journal of Economics*, *112*(2), pp. 443-478.

Langham, E., Thorne, H., Browne, M., Donaldson, P., Rose, J., and Rockloff, M. (2016) 'Understanding gambling related harm: a proposed definition, conceptual framework, and taxonomy of harms', *BMC public health*, 16(1), p.80-103.

Lauriola, M. and Levin, I. P. (2001) 'Personality traits and risky decision-making in a controlled experimental task: An exploratory study', *Personality and Individual Differences*, 31(2), pp. 215-226

Lautenschlager, N. T. and Almeida, O. P. (2006) 'Physical activity and cognition in old age', *Current opinion in Psychiatry*, *19*(2), pp. 190-193.

Lawrance, E. C. (1991) 'Poverty and the rate of time preference: evidence from panel data', *Journal of Political economy*, *99*(1), pp. 54-77.

Lee, K. and Ashton, M. C. (2004) 'Psychometric properties of the HEXACO personality inventory', *Multivariate behavioral research*, 39(2), pp. 329-358.

Levandovski, R., Dantas, G., Fernandes, L. C., Caumo, W., Torres, I., Roenneberg, T. and Allebrandt, K. V. (2011) 'Depression scores associate with chronotype and social jetlag in a rural population', *Chronobiology international*, *28*(9), pp. 771-778.

Levin, K. A. (2006) 'Study design III: Cross-sectional studies', *Evidence-based dentistry*, *7*(1), pp. 24-25.

Li, G. (2014) 'Information sharing and stock market participation: Evidence from extended families', *Review of Economics and Statistics*, 96(1), pp. 151-160.

Li, S. X., Wang, X. F., Liu, L. J., Liu, Y., Zhang, L. X., Zhang, B., and Lu, L. (2011) 'Preliminary test for the Chinese version of the Morningness–Eveningness Questionnaire', *Sleep and Biological Rhythms*, *9*(1), pp. 19-23.

Li, Y., Baldassi, M., Johnson, E. J., and Weber, E. U. (2013) 'Complementary cognitive capabilities, economic decision-making, and aging', *Psychology and Aging*, 28(3), pp. 595-613.

Likert, R. A. 1932 'A technique for the measurement of attitudes', *Archives of Psychology*, 140, pp. 5-55.

Liu, X., Song, Y., Wu, K., Wang, J., Li, D., and Long, Y. (2015) 'Understanding urban China with open data', *Cities*, 47, pp. 53-61.

Llieva, J., Baron, S. and Healey, N. M. (2002) 'Online surveys in marketing research: Pros and cons', *International Journal of Market Research*, 44(3), pp. 361–367.

Love, D. A. (2010) 'The effect of marital status and children on savings and portfolio choice', *Review of Financial Studies*, 23(1), pp. 385–432.

Love, D. A. and Smith, P. A. (2010) 'Does health affect portfolio choice?' *Health Economics*, 19(12), pp. 1441–1460.

Lowry, P.B. and Gaskin, J. (2014) 'Partial least squares (PLS) structural equation modeling (SEM) for building and testing behavioral causal theory: When to choose it and how to use it', *IEEE transactions on professional communication*, 57(2), pp.123-146.

Lundberg, S., Startz, R., and Stillman, S. (2003) 'The retirement-consumption puzzle: A marital bargaining approach', *Journal of Public Economics*, 87(5), pp.1199–1218.

Lupien, S. J., Wilkinson, C. W., Brière, S., Ménard, C., Kin, N. N. Y., and Nair, N. P. V. (2002) 'The modulatory effects of corticosteroids on cognition: studies in young human populations', *Psychoneuroendocrinology*, *27*(3), pp. 401-416.

Lusardi, A. and Mitchell, O. S. (2008) 'Planning and Financial Literacy: How Do Women Fare?' *American Economic Review*, 98, pp. 413–417.

Lusardi, A. and Mitchell, O. S. (2007) 'Baby Boomer Retirement Security: The Roles of Planning, Financial Literacy, and Housing Wealth', *Journal of Monetary Economics*, 54, pp. 205–224.

Lusardi, A. and Mitchell, O. S. (2011). Financial literacy and planning: Implications for retirement wellbeing (No. w17078). National Bureau of Economic Research.

Lusardi, A. and Mitchell, O. S. (2014) 'The economic importance of financial literacy: Theory and evidence', *Journal of Economic Literature*, 52, pp. 5-44.

Lusardi, A. and Mitchelli, O.S. (2007) 'Financial literacy and retirement preparedness: Evidence and implications for financial education', *Business economics*, *42*(1), pp. 35-44.

MacKinnon, D. P., Lockwood, C. M., and Williams, J. (2004) 'Confidence limits for the indirect effect: Distribution of the product and resampling methods', *Multivariate Behavioural Research*, 39, pp. 99–128.

Maestripieri, D. (2014) 'Night owl women are similar to men in their relationship orientation, risk-taking propensities, and cortisol levels: Implications for the adaptive significance and evolution of eveningness', *Evolutionary Psychology*, *12*(1), pp. 130-147.

Mandell, L. and Klein, L. S. (2009) 'The impact of financial literacy education on subsequent financial behavior', *Financial Counselling Planning*, 20(1), pp. 15-24.

Fama, E. F. (1970) 'Efficient capital markets: A review of theory and empirical work', *The journal of Finance*, 25(2), pp. 383-417.

Mani, A., Mullainathan, S., Shafir, E., and Zhao, J. (2013) 'Poverty impedes cognitive function', *Science*, *341*(6149), pp. 976-980.

Mankiw, N. G. (1986) 'The equity premium and the concentration of aggregate shocks', *Journal of Financial Economics*, 17(1), pp. 211-219.

Marin, M. F., Lord, C., Andrews, J., Juster, R. P., Sindi, S., Arsenault-Lapierre, G., and Lupien, S. J. (2011) 'Chronic stress, cognitive functioning and mental health', Neurobiology of learning and memory, 96(4), pp. 583-595.

Marlatt, G.A. (1985) 'Controlled drinking: the controversy rages on', *American Psychologist*, 40, pp. 374–375.

Martin, J. S., Hébert, M., Ledoux, É., Gaudreault, M., and Laberge, L. (2012) 'Relationship of chronotype to sleep, light exposure, and work-related fatigue in student workers', *Chronobiology international*, *29*(3), pp. 295-304.

Martocchio, J. J. and Judge, T. A. (1997) 'Relationship between conscientiousness and learning in employee training: mediating influences of self-deception and self-efficacy', *Journal of Applied Psychology*, *82*(5), pp. 764-773.

McArdle, J. J., Ferrer-Caja, E., Hamagami, F., and Woodcock, R. W. (2002) 'Comparative longitudinal structural analyses of the growth and decline of multiple intellectual abilities over the life span', *Developmental Psychology*, 38(1), pp. 115-142.

McArdle, J. J., Smith, J. P., and Willis, R. (2009). Cognition and economic outcomes in the Health and Retirement Survey (No. w15266). National Bureau of Economic Research.

McCrae, R. R. and Costa Jr, P. T. (1997) 'Personality trait structure as a human universal', *American Psychologist*, 52, pp. 509-516.

McKelvey, R. D. and Zavoina, W. (1975) 'A statistical model for the analysis of ordinal level dependent variables', *Journal of mathematical sociology*, 4(1), pp.103-120.

McLaughlin, C., Bowman, M. L., Bradley, C. L., and Mistlberger, R. E. (2008) 'A Prospective Study of Seasonal Variation in Shift-Work Tolerance', *Chronobiology international*, 25(2-3), 455-470.

Mehmetoglu, M. and Jakobsen, T. G. (2016). *Applied statistics using Stata: a guide for the social sciences*. London: Sage.

Meier, S. and Sprenger, C. (2010) 'Present-biased preferences and credit card borrowing', *American Economic Journal: Applied Economics*, *2*(1), pp. 193-210.

Merikanto, I., Kronholm, E., Peltonen, M., Laatikainen, T., Lahti, T., and Partonen, T. (2012) 'Relation of chronotype to sleep complaints in the general Finnish population', *Chronobiology international*, *29*(3), pp. 311-317.

Messerlian, C., Derevensky, J., and Gupta, R. (2005) 'Youth gambling problems: A public health perspective', *Health promotion international*, 20(1), pp. 69-79.

Meterko, M., Restuccia, J. D., Stolzmann, K., Mohr, D., Brennan, C., Glasgow, J., and Kaboli, P. (2015) 'Response rates, nonresponse bias, and data quality: results from a national survey of senior healthcare leaders', *Public Opinion Quarterly*, 79(1), pp. 130-144.

Meyer, B. D. and Sullivan, J. X. (2013) 'Consumption and income inequality and the great recession', *The American Economic Review*, 103(3), pp. 178-183.

Milfont, T. L. and Schwarzenthal, M. (2014) 'Explaining why larks are future-oriented and owls are present-oriented: Self-control mediates the chronotype–time perspective relationships', *Chronobiology international*, *31*(4), pp. 581-588.

Mishra, S., Lalumière, M. L., and Williams, R. J. (2010) 'Gambling as a form of risk-taking: Individual differences in personality, risk-accepting attitudes, and behavioral preferences for risk', *Personality and Individual Differences*, *49*(6), pp. 616-621.

Missildine, W. H. (ed.) (1963) *Your inner child of the past*. New York: Simon & Schuster.

Mongrain, V., Paquet, J., and Dumont, M. (2006) 'Contribution of the photoperiod at birth to the association between season of birth and diurnal preference', *Neuroscience letters*, *406*(1), pp. 113-116.

Montford, W. and Goldsmith, R. E. (2016) 'How gender and financial self-efficacy influence investment risk taking', *International journal of consumer studies*, 40(1), pp. 101-106.

Morin, R. A. and Suarez, A. F. (1983) 'Risk aversion revisited', *The Journal of Finance*, 38(4), pp. 1201-1216.

Mosca, I. and McCrory, C. (2016) 'Personality and wealth accumulation among older couples: Do dispositional characteristics pay dividends?' *Journal of Economic Psychology*, *56*, pp. 1-19.

Murphy, S. (Ed.) (2012) *The Oxford handbook of sport and performance psychology*. Oxford: University Press.

Nakade, M., Takeuchi, H., Kurotani, M., and Harada, T. (2009) 'Effects of meal habits and alcohol/cigarette consumption on morningness-eveningness preference and sleep habits by Japanese female students aged 18–29', *Journal of physiological anthropology*, *28*(2), pp. 83-90.

Natale, V. and Cicogna, P. (2002) 'Morningness-eveningness dimension: is it really a continuum?' *Personality and Individual Differences*, 32(5), pp. 809-816.

Natale, V. and Di Milia, L. (2011) 'Season of birth and morningness: comparison between the northern and southern hemispheres', *Chronobiology international*, *28*(8), pp. 727-730.

Natale, V. and Lorenzetti, R. (1997) 'Influences on Morningness–eveningness and time of day on narrative comprehension', *Personality and Individual Differences*, 23(4), pp. 685–690.

Nelson, R. J. (ed.) (2011) *An introduction to behavioral endocrinology*. 4th edn. Sunderland, MA: Sinauer.

Neter, J., Kutner, M. H., Nachtsheim, C. J., and Wasserman, W. (eds) (2004) *Applied linear statistical models*. 4th edn. Boston: McGraw-Hill, vol. 4, p. 318.

Nicholson, N., Soane, E., Fenton-O'Creevy, M., and Willman, P. (2005) 'Personality and domain-specific risk taking', *Journal of Risk Research*, *8*(2), pp. 157-176.

Norvilitis, J. M., Merwin, M. M., Osberg, T. M., Roehling, P. V., Young, P., and Kamas, M. M. (2006) 'Personality factors, money attitudes, financial knowledge, and credit-card debt in college students', *Journal of Applied Social Psychology*, 36(6), pp. 1395-1413.

Nowack, K. and van der Meer, E. (2013) 'Are larks future-oriented and owls present-oriented? Age-and sex-related shifts in chronotype–time perspective associations', *Chronobiology international*, *30*(10), pp. 1240-1250.

Ofstedal, M. B., Fisher, G. G., and Herzog, A. R. (2005). *Documentation of cognitive functioning measures in the Health and Retirement Study*. Ann Arbor: University of Michigan Survey Research Centre. Available at: http://hrsonline.isr.umich.edu/sitedocs/userg/dr-006.pdf (Downloaded: 17 November 2017)

Olson, B. D. and Suls, J. (2000) 'Self-, other-, and ideal-judgments of risk and caution as a function of the five-factor model of personality', *Personality and Individual Differences*, 28(3), pp. 425-436.

Pacht, A. R. (1984) 'Reflections on perfection', *American psychologist*, *39*(4), pp. 386-390.

Palfai, T. P. and Salovey, P. (1993) 'The influence of depressed and elated mood on deductive and inductive reasoning', *Imagination, Cognition and Personality*, *13*(1), pp. 57 -71.

Pålsson, A. M. (1996) 'Does the degree of relative risk aversion vary with household characteristics?' *Journal of economic psychology*, 17(6), pp. 771-787.

Papke, L. E. and Wooldridge, J. M. (1996) 'Econometric methods for fractional response variables with an application to 401(k) plan participation rates', *Journal of Applied Econometrics*, 11, pp. 619–632.

Papke, L. E. and Wooldridge, J. M. (2008) 'Panel data methods for fractional response variables with an application to test pass rates', *Journal of Econometrics*, 145(1), pp. 121–133.

Parker, S. K., Williams, H. M., and Turner, N. (2006) 'Modeling the antecedents of proactive behavior at work', *Journal of applied psychology*, *91*(3), pp. 636-652.

Parks-Leduc, L., Feldman, G., and Bardi, A. (2015) 'Personality traits and personal values: A meta-analysis', *Personality and Social Psychology Review*, *19*(1), pp. 3-29.

Paz, S. H., Spritzer, K. L., Morales, L. S., and Hays, R. D. (2013) 'Evaluation of the Patient-Reported Outcomes Information System (PROMIS®) Spanish physical functioning items', *Quality of Life Research*, 22(7), pp. 1819–1830.

Peress, J. (2004) 'Wealth, information acquisition, and portfolio choice', *Review of Financial Studies*, 17(3), pp. 879–914.

Perry, V. G. and Morris, M. D. (2005) 'Who is in control? The role of self-perception, knowledge, and income in explaining consumer financial', *Behavior.Journal of Consumer Affairs*, 39(2), pp. 299-313.

Phillips, D., Lin, Y. C., Wilkens, J., Chien, S., Moldoff, M., Lee, J., and Zamarro, G. (2017). *Harmonized ELSA Documentation*, Version E. USC Dornsife Center for Economic and Social Research.

Piffer, D., Ponzi, D., Sapienza, P., Zingales, L., and Maestripieri, D. (2014) 'Morningness–eveningness and intelligence among high-achieving US students: Night owls have higher GMAT scores than early morning types in a top-ranked MBA program', *Intelligence*, *47*, 107-112.

Pornpitakpan, C. (1998) 'Psychometric properties of the composite scale of morningness: a shortened version', *Personality and Individual Differences*, *25*(4), pp. 699-709.

Preacher, K. J. and Hayes, A. F. (2004) 'SPSS and SAS procedures for estimating indirect effects in simple mediation models', *Behaviour Research Methods, Instruments, and Computers*, 36(4), pp. 717-731.

Preacher, K. J. and Hayes, A. F. (2008) 'Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models', *Behaviour Research Methods*, 40(3), pp. 879–891.

Qualtrics. (2014). ESMOR 28 Questions to help research buyers of online samples. Available at: http://success.qualtrics.com/rs/qualtrics/images/ESOMAR%2028%202014.pdf (Accessed: 7 July 2017).

Randler, C. (2008a) 'Morningness–eveningness, sleep–wake variables and big five personality factors', *Personality and Individual Differences*, 45(2), pp. 191-196.

Randler, C. (2008b) 'Morningness-eveningness comparison in adolescents from different countries around the world', *Chronobiology International*, *25*(6), pp. 1017-1028.

Randler, C. (2008c) 'Psychometric properties of the German version of the Composite Scale of Morningness', *Biological Rhythm Research*, *39*(2), pp. 151-161.

Randler, C. (2009) 'Proactive people are morning people', *Journal of Applied Social Psychology*, *39*(12), pp. 2787-2797.

Randler, C. and Saliger, L. (2011) 'Relationship between morningness–eveningness and temperament and character dimensions in adolescents', *Personality and Individual Differences*, *50*(2), pp. 148-152.

Randler, C. and Schaal, S. (2010) 'Morningness–eveningness, habitual sleep-wake variables and cortisol level', *Biological psychology*, *85*(1), pp. 14-18.

Randler, C., Ebenhöh, N., Fischer, A., Höchel, S., Schroff, C., Stoll, J. C., and Vollmer, C. (2012) 'Chronotype but not sleep length is related to salivary testosterone in young adult men', *Psychoneuroendocrinology*, 37(10), pp. 1740-1744.

Raiffa, H. (ed.) (1968). *Decision Analysis: Introductory Lectures on Choices Under Undertainty*. Reading, Mass: Addison-Wesley.

Rao, Y., Mei, L., and Zhu, R. (2016) 'Happiness and stock-market participation: Empirical evidence from China', *Journal of Happiness Studies*, *17*(1), pp. 271-293.

Remund, D. L. (2010) 'Financial literacy explicated: the case for a clearer definition in an increasingly complex economy', *Journal of Consumer Affairs*, 44(2), pp. 276-295.

Rice, K. G. and Aldea, M. A. (2006) 'State dependence and trait stability of perfectionism: A short-term longitudinal study', *Journal of Counselling Psychology*, 53, pp. 205-213. doi:10.1037/0022-0167.53.2.205

Riley Jr, W. B., and Chow, K. V. (1992) 'Asset allocation and individual risk aversion', *Financial Analysts Journal*, *48*(6), pp. 32-37.

Rindfuss, R. R., Choe, M. K., Tsuya, N. O., Bumpass, L. L., and Tamaki, E. (2015) 'Do low survey response rates bias results? Evidence from Japan', *Demographic Research*, 32(36), pp. 797-828. doi:10.4054/DemRes.2015.32.26.

Ringle, C. M., Wende, S., and Becker, J. M. (eds) (2014) *Smartpls 3*. Hamburg: SmartPLS.

Roalf, D. R., Mitchell, S. H., Harbaugh, W. T., and Janowsky, J. S. (2011) 'Risk, reward, and economic decision making in aging', *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, doi:10.1093/geronb/gbr099 (Advance online publication).

Roberts, R. D. and Kyllonen, P. C. (1999) 'Morningness–eveningness and intelligence: Early to bed, early to rise will likely make you anything but wise!' *Personality and Individual Differences*, 27(6), pp. 1123–1133.

Roccas, S., Sagiv, L., Schwartz, S. H., and Knafo, A. (2002) 'The Big Five personality factors and personal values', *Personality and Social Psychology Bulletin*, 28, pp. 789-801.

Roeser, K., Obergfell, F., Meule, A., Vögele, C., Schlarb, A. A., and Kübler, A. (2012) 'Of larks and hearts—morningness/eveningness, heart rate variability and cardiovascular stress response at different times of day', *Physiology & behavior*, *106*(2), pp. 151-157.

Rosen, A. B., Tsai, J. S., and Downs, S. M. (2003) 'Variations in risk attitude across race, gender, and education', *Medical Decision Making*, *23*(6), pp. 511-517.

Rosen, A. M., Murkofsky, C. A., Steckler, N. M., and Skolnick, N. J. (1989) 'A comparison of psychological and depressive symptoms among restricting anorexic, bulimic-anorexic, and normal-weight bulimic patients', *International Journal of Eating Disorders*, 8, pp. 657-663.

Rosen, H. S., and Wu, S. (2004) 'Portfolio choice and health status', *Journal of Financial Economics*, *72*(3), pp. 457-484.

Ruberton, P. M., Gladstone, J., and Lyubomirsky, S. (2016) 'How your bank balance buys happiness: The importance of "cash on hand" to life satisfaction', *Emotion*, 16, pp. 575–580.

Ryan, R. M. and Deci, E. L. (2001) 'On happiness and human potentials: A review of research on hedonic and eudaimonic well-being', *Annual Review of Psychology*, 52(1), pp. 141–166.

Sagar, S. S. and Stoeber, J. (2009) 'Perfectionism, fear of failure, and affective responses to success and failure: The central role of fear of experiencing shame and embarrassment', *Journal of Sport and Exercise Psychology*, *31*(5), pp. 602-627.

Saunders, M., Lewis, P., and Thornhill, A. (eds.) (2012) *Research Methods for Business Students*. 6th Edn. London, UK: Pearson.

Santos-Vijande, M. L., López-Sánchez, J. Á., and Rudd, J. (2016) 'Frontline employees' collaboration in industrial service innovation: routes of co-creation's effects on new service performance', *Journal of the Academy of Marketing Science*, 44(3), pp. 350-375.

Sarstedt, M., Schwaiger, M., and Ringle, C. M. (2009) 'Do we fully understand the critical success factors of customer satisfaction with industrial goods?-Extending Festge and Schwaiger's model to account for unobserved heterogeneity', *Journal of business market management*, 3(3), pp. 185-206.

Sassaroli, S., Lauro, L. R., Ruggiero, G. M., Mauri, M. C., Vinai, P., and Frost, R. (2008) 'Perfectionism in depression, obsessive-compulsive disorder and eating disorders', *Behaviour Research and Therapy*, 46(6), pp. 757-765.

Scheaffer, R. L., Mendenhall, W., Ott, R. L., and Gerow, K. G. (eds) (2011) *Elementary survey sampling*. Belmont, California: Duxbury Press.

Schunk, D. H. (1991) 'Self-efficacy and academic motivation', *Educational psychologist*, *26*(3-4), pp. 207-231.

Schwartz, S. H. (1992) 'Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries', *Advances in experimental social psychology*, *25*, pp. 1-65.

Schwartz, S. H., Cieciuch, J., Vecchione, M., Davidov, E., Fischer, R., Beierlein, C., and Dirilen-Gumus, O. (2012) 'Refining the theory of basic individual values', *Journal of personality and social psychology*, 103(4), 663-688.

Schwarzer, R. and Jerusalem, M. (1995). Generalized self-efficacy scale, in Weinman, J., Wright, S., and Johnson, M. (eds) *Measuring in health psychology: A user's portfolio*. Causal and control beliefs. Windsor, England: NEFR-NELSON, pp. 35-37.

Scullin, M. K. and Bliwise, D. L. (2015) 'Sleep, cognition, and normal aging: integrating a half century of multidisciplinary research', *Perspectives on Psychological Science*, *10*(1), pp. 97-137.

Seibert, S. E., Crant, J. M., and Kraimer, M. L. (1999). Proactive personality and career success. *Journal of applied psychology*, *84*(3), pp. 416-427.

Shafran, R. and Mansell, W. (2001) 'Perfectionism and psychopathology: A review of research and treatment', *Clinical Psychology Review*, *21*(6), pp. 879-906.

Shamosh, N. A. and Gray, J. R. (2008) 'Delay discounting and intelligence: A meta-analysis', *Intelligence*, 36(4), pp. 289–305.

Sherry, S. B., Stoeber, J., and Ramasubbu, C. (2016) 'Perfectionism explains variance in self-defeating behaviors beyond self-criticism: Evidence from a cross-national sample', *Personality and Individual Differences*, 95, pp. 196-199.

Sims, C. A. (2003) 'Implications of rational inattention', *Journal of Monetary Economics*, 50(3), pp. 665–690.

Singleton Jr, R., Strait, B. C., Strait, M. M., and McAllister, R. J. (eds) (2010) *Approaches to Social Research*. 5th edn. Oxford: Oxford University Press.

Smith, C. S., Reilly, C., and Midkiff, K. (1989). Evaluation of three circadian rhythm questionnaires with suggestions for an improved measure of morningness. *Journal of Applied psychology*, *74*(5), pp. 728-738.

Smith, J. W., Evans, A. T., Costall, B., and Smythe, J. W. (2002) 'Thyroid hormones, brain function and cognition: A brief review', *Neuroscience and Biobehavioral Reviews*, 26(1), pp. 45-60.

Smith, H.L. (2009) 'Double sample to minimize bias due to non-response in a mail survey', in Ruiz-Gazen, P. G. A., Haziza, D., and Tille, Y (eds). Survey methods: applications to longitudinal studies, to health, to electoral studies and to studies in developing countries. Paris: Dunod, pp. 334-339.

Soane, E., Dewberry, C. and Narendran, S. (2010) 'The role of perceived costs and perceived benefits in the relationship between personality and risk-related choices', *Journal of Risk Research*, 13(3), pp. 303-318.

Sobel, M. E. (1982) 'Asymptotic confidence intervals for indirect effects in structural equation models', *Sociological Methodology*, 13, pp. 290-312.

Soon, C. S., Brass, M., Heinze, H. J., and Haynes, J. D. (2008) 'Unconscious determinants of free decisions in the human brain', *Nature neuroscience*, 11(5), pp. 543-545.

Stajkovic, A.D. and Luthans, F. (1998) 'Self-efficacy and work-related performance: a meta-analysis', *Psychological Bulletin*, 124(2), pp. 240–261.

Stango, V. and Zinman, J. (2009) 'Exponential growth bias and household finance', *The Journal of Finance*, 64(6), pp. 2807-2849.

Stanton, J. M. (1998) 'An empirical assessment of data collection using the Internet', *Personnel Psychology*, 51, pp. 709-725.

Statista. (2017) *Number of internet users in China from 2015 to 2022 (in millions)*. Available at https://www.statista.com/statistics/278417/number-of-internet-users-in-china/ (Accessed: 7 December 2017).

Steptoe, A., Breeze, E., Banks, J., and Nazroo, J. (2012). Cohort profile: the English longitudinal study of ageing. *International journal of epidemiology*, 42(6), pp. 1640-1648.

Sternberg, R. J. and Zhang, L. F. (eds) (2014) *Perspectives on thinking, learning, and cognitive styles*. New York: Routledge.

Stoeber, J. and Becker, C. (2008) 'Perfectionism, achievement motives, and attribution of success and failure in female soccer players', *International Journal of Psychology*, 43, pp. 980-987.

Stoeber, J. and Kersting, M. (2007) 'Perfectionism and aptitude test performance: Testees who strive for perfection achieve better test results', *Personality and Individual Differences*, 42, pp. 1093-1103.

Stoeber, J. and Otto, K. (2006) 'Positive conceptions of perfectionism: Approaches, evidence, challenges', *Personality and Social Psychology Review*, 10, pp. 295–319.

Stoeber, J. and Childs, J. H. (2010) 'The assessment of self-oriented and socially prescribed perfectionism: Subscales make a difference', *Journal of personality assessment*, 92(6), pp. 577-585.

Stoeber, J. and Stoeber, F. S. (2009) 'Domains of perfectionism: Prevalence and relationships with perfectionism, gender, age, and satisfaction with life', *Personality and Individual Differences*, *46*(4), pp. 530-535.

Stoeber, J., Feast, A. R., and Hayward, J. A. (2009) 'Self-oriented and socially prescribed perfectionism: Differential relationships with intrinsic and extrinsic motivation and test anxiety', *Personality and Individual Differences*, 47, pp. 423-428.

Stoeber, J., Hutchfield, J., and Wood, K. V. (2008) 'Perfectionism, self-efficacy, and aspiration level: Differential effects of perfectionistic striving and self-criticism after success and failure', *Personality and individual differences*, 45, pp. 323-327.

Stoeber, J., Kempe, T., and Keogh, E. J. (2008a) 'Facets of self-oriented and socially prescribed perfectionism and feelings of pride, shame, and guilt following success and failure', *Personality and Individual Differences*, *44*(7), pp. 1506-1516.

Stoeber, J., Otto, K., and Dalbert, C. (2009b) 'Perfectionism and the Big Five: Conscientiousness predicts longitudinal increases in self-oriented perfectionism', *Personality and Individual Differences*, 47(4), pp. 363-368.

Stolarski, M., Ledzińska, M., and Matthews, G. (2013) 'Morning is tomorrow, evening is today: relationships between chronotype and time perspective', *Biological Rhythm Research*, *44*(2), pp. 181-196.

Stumpf, H. and Parker, W. D. (2000) 'A hierarchical structural analysis of perfectionism and its relation to other personality characteristics', *Personality and Individual Differences*, 28, pp. 837–852.

Sunden, A. E. and Surette, B. J. (1998) 'Gender differences in the allocation of assets in retirement savings plans', *The American Economic Review*, 88(2), pp. 207–211.

Susman, E. J., Dockray, S., Schiefelbein, V. L., Herwehe, S., Heaton, J. A., and Dorn, L. D. (2007) 'Morningness/eveningness, morning-to-afternoon cortisol ratio, and antisocial behavior problems during puberty', *Developmental psychology*, *43*(4), pp. 811-822.

Tanaka, T., Camerer, C. F., and Nguyen, Q. (2010) 'Risk and Time Preferences: Linking Experimental and Household Survey Data from Vietnam', *The American Economic Review*, *100*(1), pp. 557-571.

Tankova, I., Adan, A., and Buela-Casals, G. (1994) 'Circadian typology and individual differences. A review', *Personality and Individual Differences*, 16, pp. 671–684

Taylor, A. B., MacKinnon, D. P., and Tein, J. Y. (2008) 'Tests of the three-path mediated effect', *Organizational Research Methods*, *11*(2), pp. 241-269.

Taylor, H. (2000) 'Does Internet research work? Comparing electronic survey results with telephone survey', *International Journal of Market Research*, 42, pp. 51–63.

Thaler, R. H., Sunstein, C. R., and Nudge. (2008) 'Improving Decisions about Health, Wealth, and Happiness', *Constitutional Political Economy*, 19(4), pp.356-360.

Thompson, L. F., Surface, E. A., Martin, D. L., and Sanders, M. G. (2003) 'From paper to pixels: Moving personnel surveys to the Web', *Personnel Psychology*, 56, pp. 197–227.

Torsvall, L. and Åkerstedt, T. (1980) 'A diurnal type scale: construction, consistency and validation in shift work', *Scandinavian journal of work, environment & health*, 6, pp. 283-290.

Van de Venter, G. and Michayluk, D. (2008) 'An insight into overconfidence in the forecasting abilities of financial advisors', *Australian Journal of Management*, *32*(3), pp. 545-557.

Van de Venter, G., Michayluk, D., and Davey, G. (2012) 'A longitudinal study of financial risk tolerance', *Journal of Economic Psychology*, 33, pp. 794-800.

Van Rooij, M. C., Lusardi, A., and Alessie, R. J. (2012) 'Financial literacy, retirement planning and household wealth', *The Economic Journal*, *122*(560), pp. 449-478.

Van Rooij, M. C., Lusardi, A., and Alessie, R. J. (2011) 'Financial literacy and stock market participation', *Journal of Financial Economics*, *101*(2), PP. 449-472.

Visser, P. S., Krosnick, J. A., Marquette, J., and Curtin, M. (1996) 'Mail surveys for election forecasting? An evaluation of the Columbus Dispatch poll', *Public Opinion Quarterly*, 60(2), pp. 181-227.

Vissing-Jorgensen, A. (2002). *Towards an explanation of household portfolio choice heterogeneity: Nonfinancial income and participation cost structures*. National Bureau of Economic Research.

Vissing-Jorgensen, A. (2003) 'Perspectives on behavioral finance: Does" irrationality" disappear with wealth? Evidence from expectations and actions', *NBER Macroeconomics Annual*, 18, pp. 139-194.

von Gaudecker, M. (2015) 'How does household portfolio diversification vary with financial literacy and financial advice?' *The Journal of Finance*, 70(2), pp. 489–507.

Wang, L. and Chartrand, T. L. (2015) 'Morningness–eveningness and risk taking', *The Journal of psychology*, *149*(4), pp. 394-411.

Wang, Y. and Ruhe, G. (2007) 'The Cognitive Process of Decision Making', *International Journal of Cognitive Informatics and Natural Intelligence*, 1(2), pp. 73–85.

Walters, D. J., Fernbach, P. M., Fox, C. R., and Sloman, S. A. (2016) 'Known unknowns: A critical determinant of confidence and calibration', *Management Science*, 63(12), pp. 4298-4307.

Waterhouse, J., Edwards, B., Nevill, A., Carvalho, S., Atkinson, G., Buckley, P., and Ramsay, R. (2002) 'Identifying some determinants of "jet lag" and its symptoms: a study of athletes and other travellers', *British journal of sports medicine*, 36(1), pp. 54-60

Weller, J. A. and Thulin, E. W. (2012) 'Do honest people take fewer risks? Personality correlates of risk-taking to achieve gains and avoid losses in HEXACO space', *Personality and individual differences*, 53(7), pp. 923-926.

Wermuth, N. (1980) 'Linear recursive equations, covariance selection, and path analysis', *Journal of the American Statistical Association*, *75*(372), pp. 963-972.

Williams, J. and MacKinnon, D. P. (2008) Resampling and distribution of the product methods for testing indirect effects in complex models, *Structural Equation Modeling*, *15*(1), pp. 23-51.

Wilson, R. S., Beckett, L. A., Barnes, L. L., Schneider, J. A., Bach, J., Evans, D. A., and Bennett, D. A. (2002) 'Individual differences in rates of change in cognitive abilities of older persons', *Psychology and Aging*, 17(2), pp. 179-193.

Wilson, R. S., Beckett, L. A., Bennett, D. A., Albert, M. S., and Evans, D. A. (1999) 'Change in cognitive function in older persons from a community population: Relation to age and Alzheimer's disease', *Archives of Neurology*, 56, pp. 1274–1279.

Wittmann, M., Paulus, M., and Roenneberg, T. (2010) 'Decreased psychological well-being in late 'chronotypes' is mediated by smoking and alcohol consumption', *Substance use & misuse*, *45*(1-2), pp. 15-30.

Worldometer. (2017) *China population (Live)*. Available at http://www.worldometers.info/world-population/china-population/ (Accessed: 7 December 2017)

World Development Indicator. (2016) *Gross enrolment ratio, tertiary, both sexes (%)*. Available at: https://data.worldbank.org/indicator/SE.TER.ENRR (Accessed 9 December 2017)

Xiao, J. J. (2008). Applying behaviour theories to financial behaviour. In J.J. Xiao (Ed.), *Handbook of consumer finance research* (pp 69-81). New York: Springer.

Yang, B. and Lester, D. (2014) 'A subcultural study of credit card debt and foreclosures', *Applied Economics*, *46*(3), pp. 323-328.

Yates, J. F. (1990) *Judgment and Decision Making*. Englewood Cliffs, NJ: Prentice Hall.

Yogo, M. (2016) 'Portfolio choice in retirement: Health risk and the demand for annuities, housing, and risky assets', *Journal of Monetary Economics*, 80, pp. 17–34.

Yuen, K. S. and Lee, T. M. (2003) 'Could mood state affect risk-taking decisions?' *Journal of affective disorders*, *75*(1), pp. 11-18.

Yun, G. W. and Trumbo, C. W. (2000) 'Comparative response to a survey executed by post, email, and web form', *Journal of Computer-Mediated Communication*, 6 (1), pp.0. doi: 10.1111/j.1083-6101.2000.tb00112.x

Zeidan, F., Johnson, S. K., Diamond, B. J., David, Z., and Goolkasian, P. (2010) 'Mindfulness meditation improves cognition: Evidence of brief mental training', *Consciousness and cognition*, 19(2), pp. 597-605.

Zhao, X., Lynch, J. G., and Chen, Q. (2010) 'Reconsidering Baron and Kenny: Myths and truths about mediation analysis', *Journal of consumer research*, 37, pp. 197-206.

Zimbardo, P. G. and Boyd, J. N. (1999) 'Putting time in perspective: A valid, reliable individual-differences metric', *Journal of Personality and Social Psychology*, 77, pp. 1271-1288.

Zuckerman, M. and Kuhlman, D. M. (2000) 'Personality and risk-taking: common bisocial factors', *Journal of personality*, 68(6), pp. 999-1029.