Risk Perceptions and Financial Decisions of Individual Investors

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Abstract

Standard finance theory portrays investors as rational utility maximisers. Persisting market anomalies and observed investor practice, however, have led to widespread recognition that the fundamental axioms of rationality are often violated. In response to the limitations inherent in standard theory, the *Behavioural Finance* approach relaxes the rationality assumption and takes account of psychological influences on individuals' decision-making processes. Adopting the behavioural approach, this thesis, which includes two empirical studies, examines why, and to what extent, investors depart from rational or optimal investment practices.

The thesis examines the effect of *Myopic Loss Aversion* (MLA) suggested by Benartzi and Thaler (1995) as a response to the Equity Premium Puzzle highlighted by Mehra and Prescott (1985). While previous studies are almost exclusively based on experiments in a laboratory setting, this approach provides more compelling empirical evidence by investigating the effects of MLA on real individual investors' portfolio allocations through the use of the Dutch National Bank Household Survey.

For the first time, the concept of MLA is identified through the interaction of two separate effects, firstly, individuals' *myopia*, reflected in portfolio evaluation and rebalancing frequencies, and secondly, *loss aversion*. The thesis finds that individuals who are less affected by MLA invest more in risky financial assets. Further, individuals who are less myopic increase their share of risky assets invested in their financial portfolios over time, although this is unrelated to their loss aversion. These findings support the prediction of MLA theory that short investment horizons and high loss aversion lead to a significantly lower share of risky investments. In summary, the high equity premium can be explained by the notion of MLA. If individuals evaluate their

investment performance over the long-term, they perceive much smaller risks relative to stockholding returns; consequently, they will be prepared to accept smaller equity premiums. The findings suggest possible interventions by policy makers and investment advisors to encourage individuals to remain in the stock market, such as providing long-term investment instruments, or restricting evaluation frequency to the annual reporting of investment performance.

In response to the stockholding puzzle (Haliassos and Bertaut, 1995), this thesis also investigates individuals' *stock market returns expectations* and their varying levels of *risk aversion*. Previous studies find that individuals' heterogeneous stock market expectations determine variations in their stockholdings. The thesis accounts for the effect of risk aversion on stock market expectations, as well as on stockholding decisions. Additionally, the causality issue as between individuals' expectations and stockholding status is controlled. The thesis finds that more risk averse individuals hold lower stock market expectations, and that the stock market return expectations of more risk averse individuals affect their stock market participation decisions negatively. The portfolio allocation decisions of individuals who already hold stocks are only affected by their expectations, with risk aversion being no longer significant. The thesis argues that persistent risk aversion effects cause individuals to hold pessimistic views of stock market returns, thus contributing to the enduring stockholding puzzle.

The thesis reinforces existing perceptions that individuals in the real world may not make *fully* rational decisions due to their judgments which are based on heuristics and affected by cognitive biases. Individual investors often fail to maximise their utility given their preferences and constraints. Consequently, this thesis draws attention to the possible role of institutions, policy makers, and financial advisory bodies in providing effective interventions and guidelines to improve individuals' financial decisions.

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Chapter 1 Introduction

1.1 Motivation for the Thesis

This thesis investigates individual investors' financial decision-making under uncertainty. According to the traditional finance paradigm, individuals are self-interested agents and given a set of alternatives, their decision-making reflects a process of choosing optimal options. The optimal choice is that which maximises individuals' utility or satisfaction based on their rational preferences and all relevant information. Rational preference theory posits that individuals are able to compare all possible choices in order to serve their best interests under uncertainty (von Neumann and Morgenstern, 1944) and, in terms of individuals' wealth management, more is always better. Modern portfolio theory (Markowitz, 1952a; 1959) is predicated normatively on the assumptions that investors are rational, and that all available information is reflected instantaneously and completely in market prices so that markets remain efficient (Fama, 1965; 1970).

Financial decision-making is, however, not a simple task for individuals; especially since they are required to pay a great deal of attention to the uncertainty involved in the consequences of their decisions. In particular, given their distinct beliefs and preferences, individuals' financial decisions in the real world are virtually independent of one another. Certainly, not only their financial decisions but also many other decisions which individuals face in their lives require personal judgments reflecting their own circumstances. Furthermore, individuals often fail to maximise their utility and update their beliefs correctly, violating the fundamental axioms of rationality (Thaler, 1999a). Persistent anomalies in the markets also indicate that standard theories fail to explain these phenomena. In response, this thesis takes a

Behavioural Finance approach to describe individual investors' financial decision-making, taking account of psychological influences. Thus the first motivation of this thesis is to fill the lacuna which exists between the beliefs of standard economic theories as to 'how rational investors should behave' and those of the behavioural approach as to 'how normal investors actually behave'.

Individual investors' financial decisions are ever more important given their increasing longevity. Further, the worldwide trends of abandoning defined benefit plans in favour of defined contribution plans and of introducing new financial instruments through mutual funds and retirement accounts invite, as well as expose, more individuals than ever before to stock market fluctuations. The recent history of the stock market including the dot-com bubble, and the subprime mortgage and financial crises of 2008, however, emphasises the need for individuals to be more responsible for, and aware of, the consequences of their financial decision-making. These issues are highlighted by the previous behavioural finance studies suggesting that individuals make suboptimal decisions not only due to their lack of financial understanding (Van Rooij, Lusardi, and Alessie, 2011; 2012), but also because they are often prone to judgment biases and mistakes (De Bondt, 1998), and because their financial decisions are affected by their emotional swings and sentiments (Kaplanski, Levy, Veld, and Veld-Merkoulova, 2012). Consequently, individuals' decisions to invest in risky assets are not solely determined by their assessments of the risk-return trade-off, but also by many other underlying personal traits that determine their beliefs and preferences in terms of risk-taking.

The second motivation of this thesis is to observe the phenomenon of how individuals' investment choices differ one from another. The divergences in choice on whether to participate in the stock market or not, and on how much of their financial

assets individuals allocate to stocks are investigated by evaluating their intrinsic psychological characteristics. In addition, by providing insights into the manner in which individuals make financial decisions, the thesis seeks to draw attention to the role of institutions, policy makers, and financial advisory bodies in providing effective interventions to compensate for individuals' judgment biases and guidelines in such a way that they achieve sound investment results.

In particular, the thesis focuses on the fundamental role of individuals' risk perceptions in their financial decision-making. Taking account of the effects of individuals' varying levels of loss aversion and risk aversion as described by *Prospect Theory* (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992), the thesis investigates how individuals' investment decisions differ depending both on the manner by which they perceive the returns on their own investment portfolios and on stock market returns. In contrast to expected utility theory which assumes that individuals make consistent decisions regardless of how relevant information is presented, psychologists have argued that individuals' decisions are affected by the choice of presentation (Kahneman and Tversky, 1984; Loewenstein, 1988). Individuals perceive questions differently depending on the framing of the problem and the presentation of outcomes (Kahneman, 2003), as well as their personal characteristics; the well-known example of the glass 'half-full' or 'half-empty' demonstrates that there are apparent differences in the way individuals perceive the same phenomena.

The third motivation of this thesis is to evaluate the implications of individual investors' endogenous framing choices when evaluating and rebalancing their own investment portfolios returns, as well as the effect of their perceptions as to future stock market returns in determining their investment decisions. To this end, the thesis obtains micro-level panel data and investigates individual investors' financial decisions over

time taking account of the influences of the intrinsic framings which they employ when managing their portfolios. The thesis particularly investigates the concept of Myopic Loss Aversion (Benartzi and Thaler, 1995), and individuals' perceptions of stock market movements, as well as their personal preferences.

1.2 Contributions and Main Findings of the Thesis

The thesis has a specific focus on risk perceptions of individual investors, through developing empirical models, in order to explain the heterogeneity in their financial decisions. The thesis provides responses to two closely related and enduring market conundrums; namely, the Equity Premium Puzzle (Mehra and Prescott, 1985) and the Stockholding Puzzle (Haliassos and Bertaut, 1995). Previous literature concerning these two puzzles is discussed in-depth in Chapter Two.

Chapter Three of the thesis is entitled *Myopic Loss Aversion and Stock Investments: An Empirical Study of Private Investors*[1]. This chapter explains individual investors' investment decisions empirically by applying the concept of Myopic Loss Aversion (MLA), as suggested by Benartzi and Thaler (1995), as a possible solution to the equity premium puzzle (Mehra and Prescott, 1985). In this chapter, we make two contributions in terms of, firstly, methodology and, secondly, theory. Firstly, in contrast to previous studies which evaluate the effect of MLA based on experiments (such as Thaler *et al*., 1997; Gneezy and Potters, 1997; Bellemare *et al*., 2005; Langer and Weber; 2008; Fellner and Sutter, 2009), we make a novel contribution by evaluating the effects of MLA on investors' real investment allocations.

[1]This chapter is co-authored with Professor Yulia Veld-Merkoulova (Department of Accounting & Finance, Business School, University of Glasgow, West Quadrangle, Glasgow University Avenue, Glasgow, G12 8QQ, E-mail: Yulia.Veld-Merkoulova@glasgow.ac.uk) who made a considerable contribution in rewriting the introduction to Chapter Three.

Since the study is based on information obtained from real investors, our study is free from the limitations faced by experimental studies. For example, in an experiment the subjects may not consider the consequences of a gamble seriously as the monetary returns tend to be very small. As discussed by Kahneman, Knetsch, and Thaler (1990), awarding subjects a reward for their choices also creates an endowment effect, which could distort their decisions. Subjects in most experiments are undergraduate students and they are untypical of the population of investors as a whole in terms of their experience in trading and knowledge of the market, as well as many other demographical and financial characteristics.

When we study real investors, we are able to identify important variables such as their portfolio evaluation frequency and investment horizon without any need to define them exogenously. Such variables are ideally determined solely by investors themselves rather than artificially within laboratory settings. This approach allows us to identify the true effects of MLA on real investors' decision-making processes in the market, while previous studies are successful in identifying the effect of MLA only in laboratory settings.

Secondly, we measure MLA by identifying both individual investors' myopia and loss aversion in order to account for the joint effects of these two core variables. We believe that the concept of MLA is centred on the interactions of the two separate effects, as discussed by Benartzi and Thaler (1995). To the best of our knowledge, this is the first empirical study to identify the effect of MLA by investigating the interactions between investors' myopia and loss aversion.

Although the effect of myopia was originally measured by investors' portfolio evaluation frequency alone (Thaler *et al.*, 1997; Gneezy and Potters, 1997), the rebalancing frequency, i.e. the frequency of adjusting the proportions of risky assets

held in a financial portfolio, is introduced by Gneezy, Kapteyn, and Potters (2003) as an additional proxy. Consequently, we obtain both investors' evaluation and rebalancing frequencies by questions submitted to the CentERdata panel at Tilburg University in the Netherlands in the year 2003. These questions, which measure individuals' levels of myopia, are then merged with other datasets from the annual Dutch National Bank Household survey (DHS). Investors' loss aversion measures are based on the hypothetical inter-temporal choice questions asked by the DHS over the period 1997-2002. After obtaining the aggregate assets and liabilities set from the DHS for the period 1997-2010, we investigate a total of 400 investors' portfolio allocation decisions over time in order to identify the effect of MLA.

Following Benartzi and Thaler (1995), the first question we investigate in this study is whether those individuals who are less affected by MLA invest more in risky financial assets. Secondly, we evaluate the effect of MLA by considering the persistence effect of MLA on individuals' portfolio allocation changes over time. We investigate whether those who are less affected by MLA increase their holdings in risky financial assets over time relative to those highly affected. In terms of methodology, since we observe the same individuals appearing on average for 8 years in our total dataset, our empirical models are based on Prais-Winston's (1954) panel-corrected standard errors (PCSE) regression models in order to correct for autocorrelations and to control for heteroskedasticity.

Based on our findings, we observe that a median investor in our sample evaluates her portfolio quarterly, but rebalances it less often than once a year. Although our results contrast with the arguments of Odean (1999) and Barber and Odean (2000; 2001) in their studies of discount brokerage accounts, to the effect that investors tend to over-trade reflecting their overconfidence, our results are in line with those of Fellner

and Sutter (2009) who, in an experimental setting, observe a high preference on the part of their subjects for frequent evaluation of investments and a somewhat less pronounced preference for short investment horizons. We find that MLA has significant and negative effects, which are driven by both individuals' loss aversion and myopia, on investors' portfolio allocations to risky financial assets. Those who are highly loss averse and exhibit a combination of high evaluation and rebalancing frequencies hold relatively smaller proportions of risky assets in their portfolios.

When we investigate investors' portfolio allocations over time, we observe the effects from myopia but not from loss aversion. Investors who evaluate their portfolios less frequently are likely to increase their holdings over time compared to those who evaluate at least monthly, and this finding remains consistent after controlling for the effects arising from stock market fluctuations.

Our findings are important as they are distinguishable from the relatively large number of prior experimental studies on MLA. We provide empirical evidence for the external validity of MLA by taking account of both loss aversion and myopia effects on individual investors' financial decision-making. We provide support for the assumptions of Benartzi and Thaler (1995) that the combination of investors' loss aversion together with both their propensity to undertake frequent portfolio evaluation and their short investment time horizon leads to a significantly lower proportion of risky financial assets in their financial portfolios, thereby reducing their lifetime utility.

Investors' alteration of their portfolios over time, however, is apparently influenced by myopia alone; this suggests possible interventions that policy makers and investment advisors can instigate to persuade investors to remain in the stock market, such as providing long-term investment instruments, or restricting investors' evaluation frequencies by reporting investment performance only annually.

Chapter Four of the thesis is entitled *Stock Market Expectations and Risk Aversion of Individual Investors*[2]. In this chapter, the first contribution we make to the existing literature is that, in response to the stockholding puzzle (Haliassos and Bertaut, 1995), we investigate the effects of the varying levels of individual investors' risk aversion, together with their stock market expectations, on their investment decisions.

Previous studies which evaluate the relationship between individuals' stock market expectations and their stock holdings do not emphasise the effects of risk aversion on either individuals' stock market expectations or on their portfolio allocation decisions (Vissing-Jørgensen, 2003; Dominitz and Manski, 2007; Hurd *et al*., 2011). We believe that studying the interdependent effects of stock market expectations and risk aversion is crucial, as Barsky, Juster, Kimball, and Shapiro (1997) and Kapteyn and Teppa (2011) both recognise that the heterogeneous effects of risk aversion significantly determine individuals' portfolio allocation decisions.

Following Rabin and Thaler (2001, p.210), who define risk aversion as *"hesitation over risky monetary prospects even when they involve an expected gain"*; we suggest that individuals' risk aversion plays a crucial role in determining the heterogeneity in their stock market return expectations. Thus, we incorporate a term to measure the interactions between risk aversion and stock market expectations in our empirical models in order to explain individuals' stock market participation decisions as well as their portfolio allocations.

We make a second contribution, in terms of research methodology, through employing Instrumental Variable (IV) estimates to control for the endogeneity issue in individuals' stock market expectations. Individuals' expectations as to future stock

2 This chapter is co-authored with Professor Leonard Rosenthal (Department of Finance, Bentley University, Waltham, Massachusetts, USA, E-mail: lrosenthal@bentley.edu); Professor Chris Veld and Professor Yulia Veld-Merkoulova (Department of Accounting & Finance, Business School, University of Glasgow, West Quadrangle, Glasgow University Avenue, Glasgow, G12 8QQ, E-mail: Chris.Veld @glasgow.ac.uk; Yulia.Veld-Merkoulova@glasgow.ac.uk)

market returns raise an issue of causality as their expectations are also determined by their stock holding status. We account for the possible effects from investors' 'wishful expectations' (Ito, 1990), as well as the deviations in individuals' expectations caused by different levels of familiarity with, and knowledge of, the stock market, in addition to accounting for potential measurement errors and omitted variable bias. Additional variables which act as instruments are introduced in our IV estimates. Thus, this approach accounts for the endogeneity issue more rigorously than do previous studies.

We investigate three research questions in this chapter. The first two questions are applied to both investors (i.e. those who hold risky financial assets) and non-investors. Firstly, we examine whether more risk averse individuals hold lower stock market return expectations. Secondly, we investigate whether the stock market return expectations of more risk averse individuals have a negative effect on their stock market participation decisions. Thirdly, we test whether the interactions between levels of risk aversion and stock market return expectations have negative effects on investors' portfolio allocation decisions, i.e. the proportion allocated to risky financial assets within their total financial portfolios.

Our data is extracted from the Dutch National Bank Household Survey (DHS) of the CentERdata panel, the same survey panel which is used for the empirical study of Chapter Three of the thesis, and both individuals' stock market expectations and risk aversion are measured on the basis of questions covering the period 2004-2006. The DHS incorporates a question which allows us to evaluate individuals' expectations as to percentage point changes in a year for stock market returns worldwide. A measure of individuals' risk aversion is obtained by applying a factor analysis to their responses for the six questions from the DHS which evaluate risk preferences with regard to investment strategy. After merging with other datasets from the DHS which provides

information on individuals' financial, demographical, and behavioural characteristics for the 3 year period, our sample includes 1587 individuals from 2956 observations.

Based on our findings, we observe pessimistic views on the part of a large proportion of Dutch individuals as to future stock market movements in that their expectations are much lower than the historical averages, supporting Hurd *et al*. (2011). With regard to the particular questions we ask in this study, we find that individuals' risk aversion levels determine their stock market expectations significantly and negatively; higher levels of risk aversion give rise to lower stock market return expectations.

Based on our IV estimates which apply the Generalised Method of Moments (GMM) approach, we observe that the joint effects of higher levels of risk aversion and stock market expectations on individuals' stock market participation decisions are significantly negative. For those investors who already hold risky financial assets in their portfolios, their varying levels of risk aversion no longer influence their portfolio allocation decisions but we continue to observe significant and positive effects on their allocations to risky financial assets as the result of their stock market expectations. We support the findings from previous studies suggesting that the heterogeneous stock market expectations of individuals provide an answer to the stockholding puzzle (Hurd *et al.*, 2011; Kézdi and Willis, 2009; Dominitz and Manski, 2007).

What truly determines the heterogeneity of individuals' expectations is a difficult issue. In addition to previous literature on individuals' biased expectations which recognises the substantial influences of factors such as individuals' own past investment returns and recent fluctuations in the stock market (Vissing-Jørgensen, 2003; De Bondt, 1993, 1998; Graham and Harvey, 2001), we argue that there are also persistent effects arising from individuals' risk aversion levels which leads them to hold

pessimistic views of the stock market returns, thus contributing to the enduring stockholding puzzle.

1.3 Summary, Conclusion and Outline of the Thesis

This thesis investigates individual investors' financial decision-making under uncertainty. Individual investors in the real world are not as rational as described in standard finance theories, often failing to maximise their utilities and update their beliefs correctly, thus violating the fundamental axioms of rationality (Thaler, 1999a). Moreover, given their distinct beliefs and preferences, individuals make financial decisions virtually independent of one another. Taking a *Behavioural Finance* approach, the thesis investigates 'how normal investors actually make investment decisions'. In particular, individuals' different investment choices are examined through evaluating their stock market participation and portfolio allocation decisions.

The thesis highlights the important role of psychology of perceptions, arguing that individuals make different investment decisions depending both on the manner by which they perceive the returns on their own investment portfolios and on stock market returns. The practical implications of the thesis are that there is an identifiable need to develop both interventions applicable to financial advisors in order to moderate the distortion in investors' decision-making resulting from their biased risk perceptions, and policy choices such as new default investment options.

The remainder of the thesis is organised as follows. Chapter Two presents a literature review. The studies on the effect of investors' Myopic Loss Aversion and on individuals' stock market return expectations are presented in Chapters Three and Four, respectively. Chapter Five includes a summary, general discussion, limitations of the study, suggestions for future research and concluding remarks.

Chapter 2 Literature Review

2.1 Background to the Thesis

2.1.1 The Behavioural Finance Approach

Standard economic and finance theories are built on the assumptions that investors are rational, and that markets are efficient (Markowitz, 1952a; 1959). Rational investors are self-interested with their foremost desire being to maximise their expected utility following von Neumann and Morgenstern's theorem (1944) which explains that the preferences of investors when evaluating risky gambles are determined by the axioms of completeness, transitivity, continuity, and independence.

All available information is reflected instantaneously and completely in the market price and investors hold rational expectations as a result of updating their probability beliefs correctly in accordance with Bayes' law. The efficient markets hypothesis assumes that competition between investors for abnormal returns drives prices to their correct values (Fama, 1965). Thus, even if some investors are not fully rational, occasionally over or underreacting to new information, markets remain rational and efficient as a result of procedures undertaken by arbitragers (Fama, 1970).

Individual investors are assumed both to manage their portfolios based on the mean-variance portfolio theory with its core theme of 'diversification' as a means of reducing total portfolio risk (Markowitz 1952a; 1959), and to act in accordance with the Capital Asset Pricing Model of Sharpe (1964) and Lintner (1965), under which portfolio performance is determined solely by the trade-off of risk and return.

In more recent years, however, there is a growing consensus that these standard theories fail to explain how real investors behave and what the results of their actions are in the markets. Persisting anomalies in the markets and the observed practices of

investors lead to arguments that the fundamental axioms of rationality are often violated, as investors fail to maximise their utilities and update their beliefs correctly, pursuing decisions which are normatively questionable (Thaler, 1999a). Standard theories may be successful in describing the financial and economic activities of an 'Economic Man' (Mill, 1836) in an abstract market, but not how real individual investors approach their financial decision-making.

In particular, De Bondt (1998), applying his empirical materials, sketches a portrait of individual investors as a 'sorry' picture after identifying various classes of anomalies reflected in investors' perceptions of asset prices and trading practices. He finds that investors tend to rely heavily on naïve patterns extrapolated from past price changes, apply 'popular models' of value (Shiller, 1990), and hold undiversified portfolios. He also finds that many individual investors are short-term oriented, exhibit excessive optimism or pessimism over time, and trade in suboptimal ways. These systematic violations by individual investors demonstrate that the classic equilibrium model lacks the ability to explain deviations from it in practice, as it is too restrictive and unrealistic to reconcile with individual investors' behaviour.

In response to the limitations faced by standard finance theories, the *Behavioural Finance* approach was developed as a new descriptive theory, taking account of psychological influences on individuals' decision-making processes. In this approach, the principle of rationality is relaxed, based on the concept of 'bounded rationality' (Simon, 1982) which argues plausibly that investors are *not* fully rational. The literature in this area has been developed based on two main building blocks; *the limits to arbitrage*, which suggests that it can be difficult for rational traders to undo the dislocations caused by less rational traders; and *psychology*, supported by the extensive experimental data collected by cognitive psychologists (Barberis and Thaler, 2003).

The failure of arbitrage in eliminating the deviations from the fundamental values caused by less rational investors explains the *limits to arbitrage*, whereas the psychological biases incorporated in investors' *beliefs* and *preferences* cast light on the reasons for the deviations. The thesis particularly investigates the influence of psychological biases on the investment decisions of individual investors.

Although standard finance theories often fail to capture how real individual investors behave given the empirical evidence, they do provide a good point of departure for behavioural finance studies. The motivation of the thesis stems from the discrepancy between theoretical predictive economic models for individuals' portfolio management and empirical observation of investor practice. Raiffa (1968) describes three approaches to decision problems: the 'normative' analysis approach describes the rational solution to arrive at ideal decisions; the 'descriptive' analysis approach defines how real people actually make decisions; and the 'prescriptive' analysis approach aims to provide practical advice to induce individuals to make more rational decisions.

Through evaluating psychological, cognitive and emotional aspects of individuals, the thesis takes a descriptive analysis approach in order to understand why, and to what extent, investors depart from rational or optimal investment practices. Further, taking a prescriptive approach, the thesis aims to recognise what types of judgment biases are likely when individuals make their financial decisions. Individuals often make their important financial decisions based on their intuitions or random tips from acquaintances instead of on the basis of critical or analytical thinking, comprehensive research, or advice from professionals. Accordingly, the thesis emphasises the important role of financial advisors and suggests what interventions might improve individual investors' decision-making in order to help them to achieve their best interests.

2.1.2 Judgment Biases of Individual Investors

According to the behavioural finance approach, individual investors' decision-making captures two vital elements, *beliefs* and *preferences* (Barberis and Thaler, 2003). Since the outcomes of investors' investment choices are unknown at the times of their decision-making, they are compelled to rely on their judgments which are determined by both their beliefs and preferences. Kahneman and Riepe (1998) argue that when individuals face highly complex financial decisions involving high uncertainty, they tend to rely on their intuitions which often reflect errors in their beliefs and preferences. Individuals tend to assign mistaken values to future outcomes or adopt incorrect combinations of probabilities and values, rather than follow rigid Bayesian rules of rational expectations (Thaler, 1999a). Kahneman and Riepe (1998) argue that due to the illusionary effects produced by their intuitions, individuals become more prone to 'judgment biases', resulting in unsatisfactory outcomes including unanticipated risks. Psychologists define 'biases' as systematic errors, or 'cognitive illusions', in individuals' judgments (Kahneman and Riepe, 1998).

Referring to the psychology of bounded rationality of Simon (1982), Kahneman (2003) argues that individuals suffer from judgment biases due to their mistaken intuitions, characterising 'intuitions' as *thoughts and preferences that come to mind quickly and without much reflection* (Kahneman, 2003; pp. 697). Kahneman (2003) further argues that individuals' intuitions can be modified or predetermined through a more deliberate mode of cognitive operation, 'reasoning'. The differences in 'accessibility' of thoughts, which refers to the speed with which thoughts come to mind, distinguish intuitions from reasoning. A two-system view of the generic modes of cognitive function has been proposed to distinguish intuitions from reasoning (Stanovich and West, 2000; Kahneman and Frederick, 2002).

Figure 1 A Two-System View of the Generic Modes of Cognitive Function

The following two-system view of the generic modes of cognitive function has been identified by Kahneman and Frederick (2002) and Kahneman (2003) in order to distinguish intuition from reasoning. This figure features the three cognitive systems of perception, intuition and reasoning as proposed by Stanovich and West (2000).

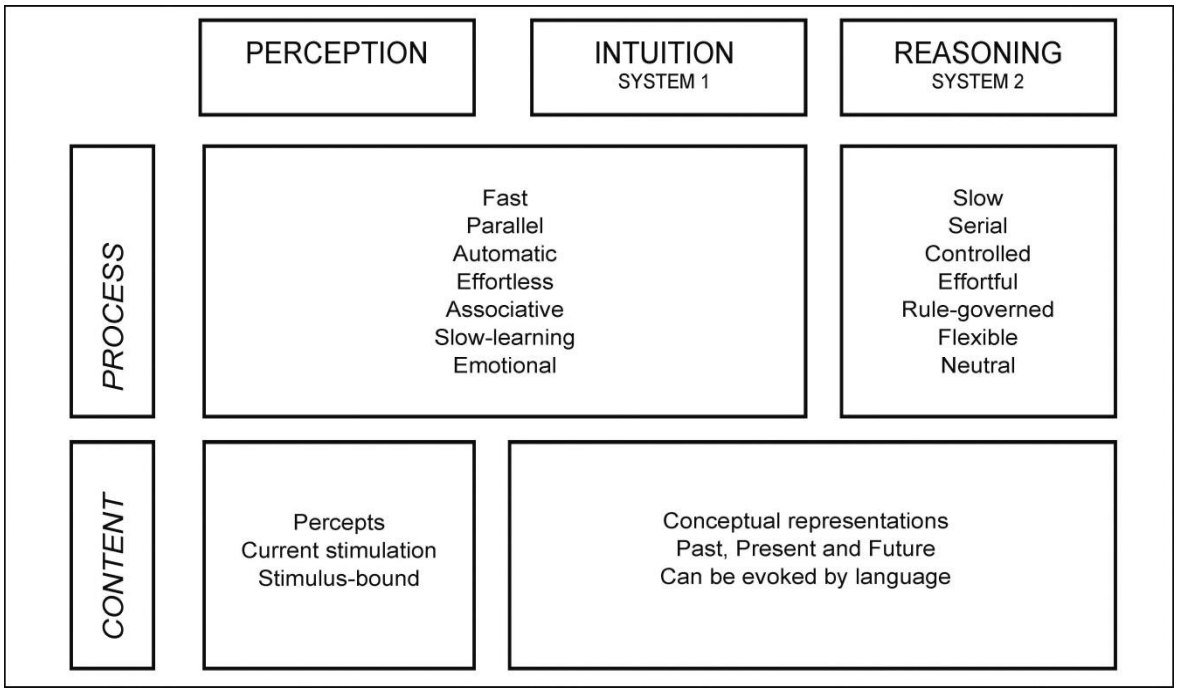


Figure 1 features the two cognitive systems as proposed by Stanovich and West (2000). Intuition in System 1 is difficult to control or modify, governed by habit, typically fast, automatic, effortless, associative, implicit, and emotionally driven; sharing the same operating process as does 'perception'. Reasoning in System 2 is usually consciously monitored and deliberately controlled, but also relatively flexible; its process is slower, serial, and effortful. Figure 1 also shows that intuition is not limited to processing current stimulations, but also that its content covers past, present, and future, as well as developing conceptual representations, as does 'reasoning'. The intuitive operations of System 1 contribute to judgments which reflect impressions and these impressions are neither intentional nor verbally explicit. Deliberate reasoning in System 2 is at all times intentional, rule governed, and explicit; it is involved in all judgments even when these are not overtly expressed (Kahneman and Frederick, 2002).

Kahneman (2003) argues that due to limited capacity for mental effort, reasoning processes are liable to interrupt each other, while intuitive processes neither cause nor suffer from interruptions when applied to more than one task simultaneously. Stanovich and West (2002) also identify one of the functions of the reasoning process of System 2 to be the monitoring of both the quality of mental operations and the intuitive process of System 1. Due to the vulnerability of System 2 to disruption of operations, however, Kahneman and Frederick (2002) argue that its monitoring function tends to be lax, allowing many intuitive, sometimes erroneous, judgments to be expressed. Kahneman and Frederick (2002) argue that due to intuitive judgments dominating the deliberate operations of reasoning, many individuals make mistakes when answering even easy questions. Tversky and Kahneman (1971) also find that even statistically sophisticated researchers make systematic errors in their statistical judgments, failing to follow statistical principles with which they are familiar. In particular, such researchers demonstrate a lack of sensitivity to sample size effects and base their judgments merely on their erroneous intuitive statistical inferences. Kahneman (2003) argues that although intuitions are often associated with poor performance, due to their indulgent and high accessible nature, whereby they employ thoughts which come to mind easily and effortlessly without demanding mental effort, individuals prefer to practice their intuitive judgments rather than apply reasoning.

The highly accessible intuitions produced by System 1 control the judgments and preferences of individual investors, unless modified or overridden by the deliberate operations of System 2 (Kahneman, 2003). Although investors undertake a conscious investment evaluation through the reasoning processes of System 2, investors suffer from erroneous intuitive judgments due to the fact that System 2 fails to monitor the activities of System 1 adequately (Kahneman and Frederick, 2002; Stanovich and West,

2002). High accessibility, the essential characteristic of intuitions, also supports many related behavioural finance arguments. Kahneman (2003) argues that framing effects are also attributable to the accessible manner by which information is presented, although individuals make different choices depending on the emphasis in framing on different aspects of information. In *Prospect Theory* (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992), utility is defined in terms of gains and losses, defining these in terms of 'changes in value', rather than of 'absolute value'. Changes in value are relatively more accessible, as they are more easily appreciated by individuals than absolute value as discussed in standard utility theory (Kahneman, 2003).

Individuals' judgment heuristics can also be explained by their highly accessible nature. Further, Kahneman and Frederick (2002) argue that individuals find 'similarity' more accessible than 'probability', and prefer 'averages' to 'sums'. In contrast to the rational expectations hypothesis, individuals tend to overweight highly accessible values when forming their expectations and this accessibility increases if these values have been observed more recently (Tversky and Kahneman, 1971; 1974). The fundamental role of 'accessibility' in individuals' cognitive psychology provides a compelling starting point to understanding individual investors' complex beliefs and preferences. Individual investors are prone to judgment biases when they base their decisions on their intuitions, trusting their perceptions which come quickly to mind. When they face investment choices, e.g. whether to invest in stocks or in bonds, avoiding the rigorous mental cognitive process necessary in order to understand the trade-off between risks and returns is likely to result in biased judgments. Consequently, when considering the two market conundrums which the thesis investigates, it is crucial to understand how individuals' cognitive functions are profoundly determined by their risk decisions.

2.2 Literature Review on Myopic Loss Aversion

2.2.1 Conception of Myopic Loss Aversion

Mehra and Prescott (1985) study the historical average equity premium between 1889 and 1978 in the US, and find a difference between returns on the S&P 500 and those on US Treasury bills of about 6%. They argue that this difference is much too high to be justified by standard economic models, unless there is implausibly high risk aversion among investors. This 'equity premium puzzle' (Mehra and Prescott, 1985) is regarded similarly in other studies. Extending the studies of Siegel (1992a; 1992b), Siegel (2007) argues that the equity premium puzzle continues to be a phenomenon in recent history; the geometric average annual returns in stock was 6.8% after correcting for inflation for the period 1871-2006 in the US, while the average rate of return on short-term government bonds was 2.8% a year. Thus, over the last hundred years, stocks have performed extremely well, achieving a premium of 4%. Siegel (2007) also argues that over the thirty year period from 1831 to 1861, stocks outperformed both short-term and long-term bonds. Dimson, Marsh, and Staunton (2002) also conclude from their study, based on analysis within sixteen countries, that real returns on stocks exceed those of bills and bonds, observing this phenomenon in many different countries including the US, the UK, Sweden, France, Germany and the Netherlands.

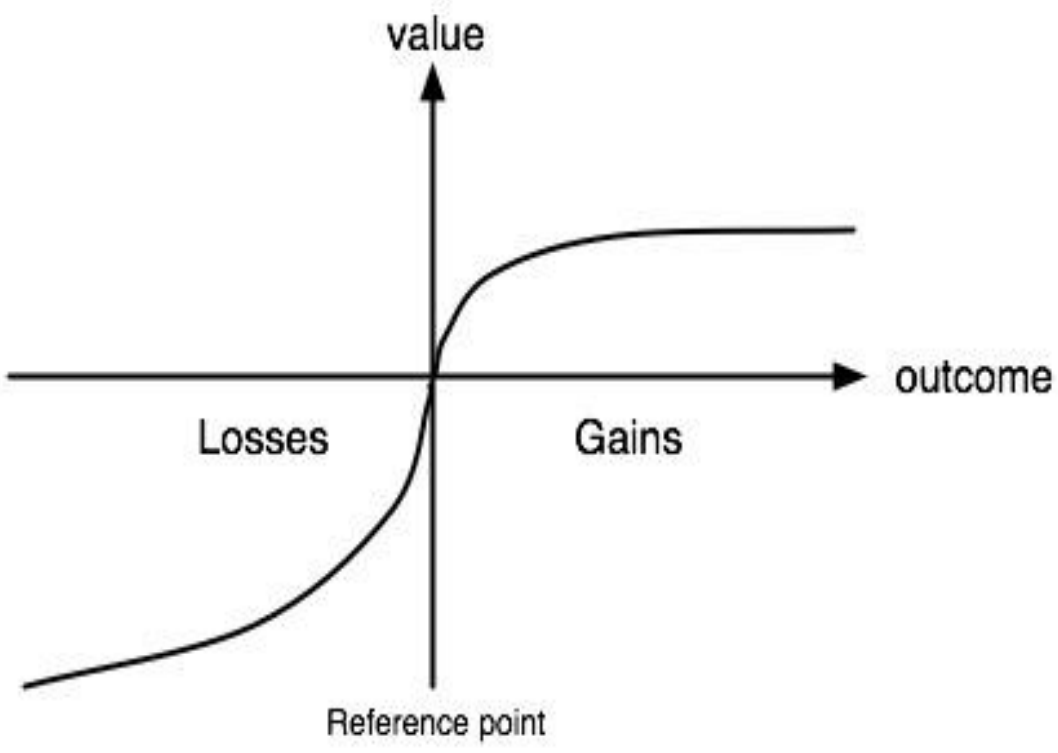
This persistent equity premium puzzle indicates that the standard finance theories based on investor rationality and market efficiency assumptions fail to live up to their predictions. Over the long-term, stocks are likely to be attractive investments given their high average returns and low covariance with consumption growth; the likely rewards are, however, accompanied by high risks which discourage investors from holding stocks, leaving a high premium (Mehra and Prescott, 1985). Consequently, understanding individuals' perceptions towards risk as well as the judgment biases

underpinning their decisions is critical. In order to explain the equity premium puzzle, Benartzi and Thaler (1995) propose the notion of *Myopic Loss Aversion* (MLA) based on two psychological concepts; *loss aversion* and *mental accounting*.

Loss aversion is the propensity of individuals to be more sensitive to their losses than to their gains, and is a core concept of the *Prospect Theory* developed by Kahneman and Tversky (1979) as an alternative model to von Neumann and Morgenstern's (1944) expected utility hypothesis as a description of the decision-making processes of individuals under conditions of uncertainty. In prospect theory (Kahneman and Tversky, 1979), utility is defined in terms of gains and losses rather than in terms of the final wealth position, as in Markowitz (1952a), and these gains and losses are valued in relation to self-defined reference points, such as the *status quo*.

Figure 2 Value Function in Prospect Theory

(Kahneman and Tversky, 1979)



Prospect theory defines the value function for individuals by an S-shaped graph as presented in Figure 2, with a kink at the origin, with the kink indicating that individuals are very conscious of even marginal changes as evaluated from the perspective of their reference points. The slope of the model is identified as concave for gains and convex for losses, and displays diminishing sensitivity in both directions; the slope is steeper, however, for losses than for gains. This difference in slope is a reflection of individuals' *loss aversion*. The slope for losses is about twice as steep as that for gains, suggesting that the pain experienced by individuals as a result of losing a given amount is more than twice the pleasure produced by gaining the same amount. As shown by the concavity of the value function, individuals are risk averse in the domain of gains, from the perspective of their individual reference points, and as represented by its convexity, risk-seeking in the domain of losses.

Mental accounting (Kahneman and Tversky, 1984) is defined as the way individuals think about a problem and is a process undertaken by individuals in order to organise, frame, code, categorise, or evaluate the outcomes from each transaction, gamble, or asset class separately over time by activating implicit methods such as cognitive actions based on their subjective criteria (Kahneman and Tversky, 1984; Thaler, 1985). Based on prospect theory, Kahneman and Tversky (1984) argue that when individuals activate their 'mental accounting', gains and losses are evaluated in relative rather than in absolute terms, as suggested by standard utility theory.

More specifically, *narrow framing* is an important feature of mental accounting which describes the tendency of individuals to define each transaction separately rather than in terms of their total wealth. Benartzi and Thaler (1995) borrow a story of Samuelson (1963), in which mental accounting plays a crucial role, to illustrate the notion of myopic loss aversion.

Samuelson offered his colleague a bet on a toss of a coin, in which there were equal chances of gaining $200 and losing $100. The colleague, however, refused to take the bet as he would feel the $100 loss more than the $200 gain; yet, was willing to accept a series of 100 such bets as long as he did not have to watch the bet being played out.

Samuelson (1963) argues that this story illustrates two specific discrepancies of human behaviour; firstly, the colleague refused to maximise his expected utility, and secondly, if he declined the particular gamble once for any particular wealth level, he should have also refused to play a sequence of such gambles (Tversky and Bar-Hillel (1983) also discuss this concept of the 'fallacy of large numbers').

Corresponding to the value function of prospect theory where the average individual' loss aversion coefficient is about 2.5 (Kahneman and Tversky, 1979), the utility function,U(·), of changes in wealth given Samuelson's bet to his colleague can be described as follows:

$$U(x) = \begin{cases} x & x \geq 0 \\ 2.5x & x < 0 \end{cases} \tag{2.1}$$

Thus, given the prospect of a single bet of P1 ($200, 0.50; -$100, 0.50), the utility of a single bet is unattractive as shown below.

$$U(P1) = 0.50(200) + 0.50\left(2.5(-100)\right) = -25 \tag{2.2}$$

Although Samuelson's single bet is unattractive to his colleague, the portfolio of bets becomes more attractive as the number of bets increases, e.g. when two bets are combined, the hypothetical expected utility which assumes that individuals weight their losses more than twice as much as their gains become positive, given the prospective distribution of P2 ($400, 0.25; $100, 0.50; -$200, 0.25). The utility of two bets being played is as below.

$$U(P2) = 0.25(400) + 0.50(100) + 0.25\left(2.5(-200)\right) = 25 \tag{2.3}$$

As Samuelson's colleague avoids watching the bet being played out, he would expect to see less chance of facing losses. He also expresses his expectations regarding overall gains which may possibly be sufficient to eliminate intermediate losses.

Benartzi and Thaler (1995) argue that the concept of loss aversion is reflected in the sentiment of Samuelson's colleague, in that he valued his losses greater than his gains, while his mental accounting activated when he showed his willingness to accept 100 bets, without re-evaluating his financial position after each individual bet. This example demonstrates that loss averse investors find risky assets less attractive if they are evaluated over the short-term, where the concept of *myopia* is determined by 'evaluation frequency'.

Thus, Benartzi and Thaler (1995) argue that this story highlights the intuition behind the notion of *myopic loss aversion*, i.e. the attractiveness of the risky asset will depend on the time horizon of the investors and the frequency of evaluating the performance of risky assets. If investors intend to hold risky assets for longer periods and evaluate the outcomes less frequently, they will be prepared to hold a greater proportion of risky assets in their portfolios.

Like Samuelson's colleague, individual investors face a virtually infinite number of risky offers in the market in respect of which they are required to make decisions simultaneously. Benartzi and Thaler (1995) argue that the attributes or intuitions behind individual investors' decisions are not as simple to measure, or as rational, as indicated by expected utility theory. Investors' subjective reference points, one of the key elements in prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992), and their framing patterns derived from their mental accounting in terms of whether they evaluate their portfolios as a whole, or on the basis of each stock individually, are also likely to influence their psychology of choice.

Given these effects of MLA, Benartzi and Thaler (1995) attempt to identify the frequency of evaluating investment portfolios which would make investors indifferent between investing all their assets either in stocks or in bonds. Based on their simulations, employing samples of historical monthly returns on stocks, bonds, and treasury bills obtained from the CRSP[3], for the period 1926-1990, Benartzi and Thaler (1995) compute the prospective utility of holding stocks, bonds and T-bills stochastically for evaluation periods starting at one month and then increasing by one month at a time. Although the CRSP stock index is compared both with T-bill returns and with five-year bond returns, in both real and nominal terms, Benartzi and Thaler (1995) consider that greater weight should be assigned to the comparison between stocks and bonds in nominal terms. They find that an evaluation frequency of one year makes the size of the equity premium consistent with parameters estimated by prospect theory (Tversky and Kahneman, 1992). Benartzi and Thaler (1995) determine that an investor with an evaluation period of one year actually behaves as if he had a one year planning horizon. Assuming that investors adopt an investment horizon of one year, they also argue that investors maximize their prospective utility when they hold a portfolio mix of 50 per cent stocks and 50 per cent bonds.

In addition, Benartzi and Thaler (1995) emphasise the importance of considering whether institutional investors demonstrate the traits of MLA as well as do individual investors. They question why pension funds do not invest a higher proportion in stocks, given the virtually infinite time horizon relevant to them. In response, they state that MLA in such settings reflects an underlying agency problem. While pension funds themselves are generally long-term institutions, the pension fund managers are often subject to short-time contract and performance evaluation. There

[3] Center for Research in Security Prices.

are, therefore, potential conflicts of interest between the manager and the stockholders. Similarly, the investments of university foundations and endowments, while made in perpetuity, are nevertheless split between stocks and bonds, due to the spending rules requiring assured levels of return each year. Thus, stock is less favoured at times of volatility in the market.

2.2.2 Previous Experimental Findings on Myopic Loss Aversion

Consistent with the theoretical arguments of Benartzi and Thaler (1995), several studies provide experimental evidence on the effects of MLA. These studies are mainly based on three different experiment designs developed respectively by Thaler *et al*. (1997), Gneezy and Potters (1997), and Langer and Weber (2008).

Thaler *et al*. (1997) examine the conjecture that myopic investors will be more willing to accept risks if they evaluate their investments infrequently, and also if the payoffs are great enough to eliminate losses. Eighty undergraduate students at the University of California at Berkeley were recruited to participate in a simulation of a series of investment allocations. They were asked to invest 100 shares for multiple periods between two funds which differ in terms of return and risk, i.e. one is a stock fund and one is a bond fund. Each subject is confronted by the same allocation problem, although the test systematically condenses their myopia by randomly allocating them to four different evaluation and reallocation scenarios. These are 'monthly' (200 trials, each trial corresponds to a single period), 'yearly' (25 trials, each trial is for eight periods), 'five-yearly' (5 trials, each trial binds for 40 periods), and 'inflated monthly' under conditions of high inflation (i.e. the same condition as 'monthly' but created by adding a constant 10 per cent to the returns of each stock and bond fund, thus subjects are assured of positive nominal returns from both funds).

The last condition, ‘inflated monthly,’ is designed to test implicitly whether the subjects exhibit money illusion by substantially increasing their preference for stocks as their experience of losses is eliminated (Shafir, Diamond, and Tversky, 1997). The subjects are committed to make the same allocation and receive feedback over committed intervals. At the termination of the experiments, an additional examination is included, asking each subject to make a final allocation which will provide no intervening feedback, and investigated over a period twice that of previous experimental trials (400 trials), thus accounting for two-thirds of the subject's total returns from the experiment.

Thaler *et al*. (1997) test, firstly, that this statistical aggregation of myopia will eliminate the experience of losses, thus inducing a higher willingness to take risks and increasing preference for stocks. They test, secondly, that a decision-maker is risk neutral in respect of gambles which fall strictly into the domain of either gains or losses, but is risk averse in respect of mixed gambles which incorporate some elements of both positive and negative outcomes.

The results of their experiment support both these predictions. Investors restricted to less frequent evaluation periods invest a higher proportion in stocks than others who are asked to evaluate outcomes more often. The subjects asked to perform monthly evaluations demonstrate greater flexibility in decision making, yet perform worst in terms of achieved returns, supporting the first prediction. Investors subject to conditions of high inflation demonstrate a greater preference for stocks, supporting the second prediction. For the final allocation, subjects demonstrate on average the same choices for one period at a time. The subjects fail to distinguish the difference between deciding on an allocation for 50 years and for a single month, consistent with the hypothesis that the subjects are radically myopic.

Thaler *et al*. (1997) also acknowledge that the influence of the mental accounting of individual investors can be assessed by investigating how often they evaluate their investment portfolios, and how they group their cross-sectional transactions, i.e. whether they evaluate one security at a time or their entire portfolio at once. Thus, if investors frame decisions narrowly, they will pursue short-term approaches rather than adopt long-term strategies, and if investors frame past outcomes narrowly, they are likely to evaluate their outcomes more frequently. This is inconsistent with the predictions of rational utility maximizing theory which predicts that investors should be unaffected by the framing of outcomes.

Gneezy and Potters (1997) develop an independent experimental test with a lottery which has a probability of 2/3 of the participants losing the amount gambled and a probability of 1/3 winning two and a half times the amount gambled. For the first part of the test, they employ nine sequences of independent rounds of the lottery and participants are required to make their choices with an endowed amount of 200 cents. For rounds 10 to 12, the second part of the test, subjects no longer receive the benefit of endowments, but instead make their investments from money earned from the first part of the experiment. Their earnings from the previous nine rounds are summed and divided by three for each round in the second part. The crucial feature of this experiment is that subjects are divided into two groups; firstly, the subjects in a high frequency group (H) receive feedback information, and are able to change their choices after *each round*, while the subjects in the other low frequency group (L) receive feedback information, and are only able to adjust their decisions after *three rounds* with the results of these three rounds being aggregated. There are fourteen experimental tests, seven for each treatment, and six participants are involved in each betting game, making 84 undergraduate students as subjects in total.

Gneezy and Potters (1997) believe, similarly to Thaler *et al*. (1997) that if subjects apply longer evaluation intervals, the trade-off between losses and gains in such lottery scenarios will be more favourable. From the manipulation of subjects' evaluation periods, they discover that subjects in low frequency groups make more risky choices. Similarly, when investors are restricted in terms of adjustment, so called 'tying their hands', they are less inclined to evaluate outcomes anxiously, thus they are prevented from withdrawing their investments as a result of occasional setbacks. Gneezy and Potters (1997) argue that fund managers should take advantage of this tendency in their marketing strategies, for example, by manipulating the evaluation period of prospective clients. Benartzi and Thaler (1999) similarly argue that the framing of investment opportunities, exemplified here by altering the evaluation period, will affect the decisions of investors. The decisions of employees in a pension plan who receive yearly returns compared to others who receive a return over 30 years, will diverge considerably, confirming the effect of aggregation on risk taking, and the influence of 'narrow framing' (Kahneman and Lovallo, 1993).

Consistent with this thinking, Gneezy, Kapteyn, and Potters (2003) introduced policy changes at Israel's largest mutual fund manager *Hapoalim* by changing the frequency of investment evaluation feedback sent to clients from every month, as in the past, to every three months. Thus, Gneezy, Kapteyn, and Potters (2003) claim that by providing investors with less frequent information feedback on the performance of risky funds, fund managers can present their funds as more attractive.

Initially, the evaluation frequency of individuals' portfolios was considered as the only driving force of myopia (Benartzi and Thaler, 1995). Gneezy, Kapteyn, and Potters (2003), however, argue that portfolio rebalancing frequency also affects asset prices in the same way as evaluation frequency, although these authors fail to

distinguish the two effects in their experiments. Subsequently, the experimental studies of Langer and Weber (2008), Bellemare *et al*. (2005) and Fellner and Sutter (2009) have attempted to disentangle the distinct effects of evaluation and rebalancing frequencies separately.

The empirical research of Langer and Weber (2008) employs a different experiment design in order to disentangle the effects of evaluation frequency and rebalancing frequency, analysing the contribution of each separately as well as the effect of their interactions. Employing 107 finance students as subjects, their computerised experiments are undertaken by means of 30 identical gambles. Given an initial endowment of €25, subjects face a choice in terms of whether to invest the total or a partial amount of their endowed resources in a lottery, which has a 40% probability of increasing the investment by 7%, and a 60% probability of decreasing it by 3%. Subjects are divided into four different conditions which are classified as (1) high evaluation frequency with high rebalancing frequency, (2) high evaluation frequency with low rebalancing frequency, (3) low evaluation frequency with high rebalancing frequency, and (4) low evaluation frequency with low rebalancing frequency. Langer and Weber (2008) determine high frequency in terms of one period and low frequency in terms of three periods of gambles in similar fashion to Gneezy and Potters (1997). They also hypothesise that rebalancing frequency has an immediate effect from the start of the experiment, while evaluation frequency influences investment decisions only over time.

From the results, Langer and Weber (2008) find that, using isolated variables, rebalancing frequency has a significant effect while no effect arises from evaluation frequency. They demonstrate that there are significant interactions between rebalancing frequency and evaluation frequency as the manipulations in combination increase the

percentage invested into the risky asset; however, the joint effect is reversed as the effect of a low rebalancing period is stronger when the evaluation frequency is high than it is when the evaluation frequency is low. Langer and Weber (2008) argue that more frequent evaluation is helpful when decisions are fixed for a long period, as the manner by which occasional losses are wiped out by larger gains over time, is important to investors. Thus Langer and Weber (2008) advise that stock funds should require investors to agree to a minimum year-long commitment and should provide them with more frequent feedback during this yearly period.

In addition, Langer and Weber (2008) examine the average allocation patterns over time, as previously Camerer and Weber (1992) argue that allocations to risky assets generally increase, resulting in risk taking, regardless of the specific treatment of myopia, as subjects become familiar with risky situations, and as ambiguity reduces over time. By comparing the first and second halves of the experiments for each treatment, they find that there is a 'trend' for investments made in the second half of the experiments to be higher than those made in the first half under three of the four conditions, thus supporting the argument of Camerer and Weber (1992).

Following the previous experimental settings of Gneezy and Potters (1997), which consist of a 'high evaluation frequency with high rebalancing frequency' condition (H), and a 'low evaluation frequency with rebalancing frequency' condition (L), Bellemare *et al.* (2005) further include a 'high evaluation frequency with low rebalancing' condition (M) to disentangle the effects of evaluation and rebalancing frequencies. They support the findings of Gneezy and Potters (1997) and further argue that high evaluation frequency systematically affects investment behaviour despite the consequences of manipulating the rebalancing frequency. They believe that the effect of myopia can be explained by evaluation frequency alone.

This result contrasts with the evidence of Langer and Weber (2008), as they find that the average investment under the condition of high evaluation frequency and low rebalancing frequency is most effective for risk taking. Bellemare *et al.* (2005) suggest that the different results of prior research may reflect the different experimental approaches adopted. Bellemare *et al*. (2005) follow the prior literature (Gneezy and Potters, 1997; Haigh and List, 2005) in applying an additive-based test that allows subjects to invest a certain amount for each period and in which the gains and losses of one period do not affect the endowments of subjects in subsequent periods. Langer and Weber (2008), however, use a multiplicative approach in which investors can transfer their initial endowment from period to period, and are allowed to reinvest their returns; their work, therefore, provides more realistic settings. Bellemare *et al*. (2005) suggest that while their experiment offers the advantage of comparability with previous works, the additive and multiplicative approaches require a more careful comparison by future research.

Following the same experimental procedure as Gneezy and Porter (1997), Fellner and Sutter (2009) demonstrate that both evaluation frequency and rebalancing frequency have equal impact on risk-taking. Fellner and Sutter (2009) divide their subjects into the same four treatments, as applied by Langer and Weber (2008), employing a 2-by-2 design for both factors on two distinct levels. Their finding that low evaluation frequency and low rebalancing frequency lead to a higher level of investment is consistent with previous arguments. Fellner and Sutter (2009) also examine the time pattern of investment behaviour, evaluating the aggregate effects of MLA by creating a panel regression model. The invested amount is the dependent variable, and the levels of evaluation and rebalancing frequencies are the main explanatory variables. The model tests how subjects react to past investment returns

through identifying the development of investment patterns over time. In line with the supposition of loss recovery identified by Staw (1976), Fellner and Sutter (2009) observe that subjects seem to react more strongly to most recent outcomes than to their accumulated wealth. Subjects invest less after repeated gains, and invest more after repeated losses. Their analysis confirms that both evaluation and rebalancing frequencies influence investment levels significantly and positively. The effects are, however, not cumulative as there are significant negative interactions between them. Counter-intuitively, investment levels are most affected positively by conditions of high evaluation frequency combined with low rebalancing frequency or by low evaluation frequency combined with high rebalancing frequency. This result appears to confirm that when at least one of either variable is of low frequency, the result is positive for the level of risky investments.

Additionally, Fellner and Sutter (2009) develop their approach of restricting or attenuating myopia through looking at the behavioural interventions of investors. The majority of their subjects, in general, are found to prefer more rebalancing flexibility and more frequent evaluation. Fellner and Sutter (2009) thus include an additional condition informing subjects of the higher average payoff from low evaluation or low rebalancing frequency in order to encourage their subjects to switch to more rewarding regimes at small cost. Results reveal, however, that when subjects switch, this is from low levels of frequency to high levels. This amendment to the experiment fails to cause a strong shift of subjects' preferences. Fellner and Sutter (2009), however, find that even with the imposition of small charges, about 75% of subjects retain a long time horizon, in respect of their initial choices, and about 66% of subjects retain a low evaluation frequency. This result suggests that the imposition of small charges is a feasible behavioural intervention.

Despite all previous experimental studies on MLA having determined the experimental conditions for their subjects exogenously, i.e. without having regard to their subjects' own preferences, Fellner and Sutter (2009) introduce an endogenous condition where subjects have the autonomy of choosing their rebalancing and evaluation frequencies. Fellner and Sutter (2009) allocate subjects to either the endogenous and exogenous condition. Under the endogenous condition, subjects choose their rebalancing and evaluation frequencies, while under the exogenous condition; subjects are allocated particular rebalancing and evaluation frequencies according to a schema of varying levels of both frequencies.

Fellner and Sutter (2009) argue that myopic symptoms tend to prevail under both endogenous and exogenous conditions; subjects, nevertheless, exhibit different reactions under each of these two conditions. Under the endogenous condition, investors generally invest more, and both evaluation and rebalancing frequencies have considerably smaller effects than in the exogenous condition. Thus, identifying an endogenous choice indicates less negative impact resulting from myopia. Additionally, endogenous subjects invest less after a number of very recent wins; however, they invest more after experiencing wins throughout all previous rounds, which is known as the 'house money effect' (Thaler and Johnson, 1990). In contrast, subjects under the exogenous condition invest more passively and seem unaffected by their past investment experience. Overall, Fellner and Sutter (2009) conclude that the results of most previous MLA studies may represent the upper limit effect of MLA as real world investors choose their rebalancing and evaluation frequencies autonomously.

Previous empirical research on MLA mainly focuses on experiments with students as a means of investigating individual investors' investment behaviour. Most individual investors, however, rely on financial advisors or professionals when making

their investment decisions due to their lack of experience and knowledge of the market. Given the increasing market participation of individual investors via pension and mutual funds, the role of financial advisors and professionals is becoming ever more important, providing a link between these individual investors and markets. It is consistent with these developments that the more recent studies of Haigh and List (2005) and of Eriksen and Kvaløy (2010) further expand the domain of experiments, including market professionals and financial advisors as subjects in order to estimate their risk preferences as well as those of students. Haigh and List (2005) undertake a field experiment with professional traders, applying a test which is identical to that of Gneezy and Potters (1997). They recruit professional traders from the Chicago Board of Trade including brokers, floor managers, market reporters, futures and options traders as well as undergraduate students, and investigate whether or not professionals' behavioural responses exhibit discrepancies similar to those of students. Haigh and List (2005) discover that anomalistic behaviour occurs to a higher degree among professional traders than it does among students.

Eriksen and Kvaløy (2010) similarly study the hypothetical investment behaviour of 50 professional financial advisors from the Norwegian bank SR-Bank. Based on the experiment designed by Gneezy and Potters (1997), they find that, consistent with the results of Haigh and List (2005), financial advisors exhibit MLA to a greater extent than do students. The findings of these studies are important since financial advisors and market professionals often have considerable influence on individual investors' financial decision-making. The negative effects of MLA on professionals' investment behaviour also reinforce the potential role of fund managers in revealing information infrequently.

Additionally, Sutter (2007), applying the experiment of Gneezy and Potters (1997), investigates whether team decision-making, in contrast to investment decision-making by individual investors, attenuates or eliminates the effects of MLA . They find that although teams make significantly more risky choices than do individuals, teams are also prone to MLA. They support the argument that there is possible attenuation of the effects of MLA as a result of team decision-making, as opposed to that of individuals, though MLA seems to be a general feature which also affects team decision-making.

Motivated by previous studies, Chapter Three of the thesis explains the influences of MLA on individual investors' actual portfolio allocation decision-making. Unlike previous studies which are largely based on experiments in laboratory settings, Chapter Three adopts a novel approach by employing a panel survey dataset which provides detailed information on investors' asset allocations. In terms of the literature, the chapter enhances the previous research by providing robust evidence for the empirical validity of the effects of MLA.

2.3 Literature Review on Individuals' Expectations

2.3.1 Literature Review on Stockholding Puzzle

In a similar vein to the Equity Premium Puzzle (Mehra and Prescott, 1985), Haliassos and Bertaut (1995) address the *Stockholding Puzzle* asking why so few households hold stocks despite the high historical equity premium. In their study, they argue that only about 25% of American households, representing all income groups, make direct investments in stocks. This phenomenon is observed similarly by King and Leape (1987) and Mankiw and Zeldes (1991). As previously discussed, standard economic theories, based on expected utility maximisation, suppose that almost all

individuals invest in stocks given the high rate of returns. The existing empirical studies, however, reveal that is not the case.

These aforementioned studies are, however, based on datasets on US households, which cover the 1970s and 1980s. By the end of the 1990s, a considerable increase in stock market participation is observed, especially in countries such as the USA and Sweden, in which about 50 per cent of households participate either directly or indirectly in the stock market. This transition resulted from the buoyant performance of stock markets in the 1990s, and from a proliferation of newly introduced financial instruments, incorporating reduced transactions, entry and information costs and which invited individuals to participate in mutual funds or retirements accounts easily (Guiso, Haliassos, and Jappelli, 2002, 2003). However, given the volatile performance of stock prices in the 21st century, this shift in stock market participation rates could be viewed as transitory, and high proportions of households in other countries still do not participate in the stock market. According to Guiso, Haliassos, and Jappelli (2002, 2003), stock market participation rates in the Netherlands, Italy, France and Germany are between 15 per cent and 25 per cent[4]. These low participation rates continue to highlight the stockholding puzzle (Haliassos and Bertaut, 1995).

Haliassos and Bertaut (1995) consider several possible reasons for this puzzle in their study, and argue that even moderate inertia, arising mainly from cultural factors such as race, gender, education or marital status, as well as costly information, can deter stockholding. Individuals lack knowledge of the stockholding process and are unfamiliar with the stock market, most especially with foreign markets. Haliassos and Bertaut (1995) also find that departures from expected-utility maximisation explain the

[4] There are a growing number of studies which compare stockholdings across countries and which try to explain discrepancies in their respective stock market participation rates. For example, studies such as Christelis, Georgarakos, and Haliassos (2011; 2012) take account of both country and household characteristics. However, their datasets do not take account of up-to-date information on stockholding rates across countries.

puzzle, as many households are not willing to trade any degree of risk for higher expected returns. While the existence of a wedge between borrowing and lending rates, and the size of minimum-investment requirements both provide plausible explanations, Haliassos and Bertaut (1995) argue that risk aversion on its own, heterogeneity of beliefs, habit persistence, and borrowing constraints all fail to explain the puzzle.

In response to the argument of Haliassos and Bertaut (1995), many studies propose alternative explanations for the stock holding puzzle. Studying the Panel Study of Income Dynamics (PSID) of US households, Vissing-Jørgensen (2002) assesses the reasons for stock market nonparticipation. She finds that fixed transactions costs inhibit stock market participation and this supposition is supported by the higher trading frequencies of wealthy households. Based on her estimations, half of the stock market nonparticipation can be explained sufficiently by a modest transaction cost of 50 dollars. Haliassos and Michaelides (2003) similarly argue that even small amounts of fixed costs incurred on entering the stock market, including information gathering costs, sign-up fees, and investor inertia, deter households' stockholding.

Bilias, Georgarakos and Haliassos (2010) draw attention to the conflicting results of previous research using discount brokerage accounts and retirement accounts, respectively. For instance, Barber and Odean (2000) witness investors' excessive trading based on discount brokerage accounts, while inactive trading in a large 401(k) plan is observed by Agnew, Balduzzi, and Sundén (2003). Subsequently, Bilias, Georgarakos and Haliassos (2010) investigate the effect of household portfolio inertia based on population-wide datasets extracted from the Panel Study of Income Dynamics (PSID) as well as from the Survey of Consumer Finances (SCF). They find a significant link between portfolio inertia and household characteristics such as low level of education and limited resources. They argue that the downturn seems to have

encouraged households to *stay* out, rather than to *get* out of the market. Furthermore, Bilias, Georgarakos and Haliassos (2010) argue that overtrading patterns in brokerage accounts are observed because owners invest only small fractions of their wealth in brokerage accounts. They support the idea of including provision for built-in trading as a default option in retirement funds in order to offset individuals' widespread inertia.

Using data from the Health and Retirement Study (HRS), Hong, Kubik, and Stein (2004) argue that social interaction affects stock market participation, arguing that 'social' investors, defined as those who interact with their neighbours or attend church, find stocks to be a more attractive investment option than do 'non-social' investors when the participation level of their peers is high. Based on the Survey of Health, Ageing and Retirement in Europe (SHARE), Christelis, Jappelli, and Padula (2010) measure three indicators of cognitive ability including mathematical ability, verbal fluency, and recall skills, for individuals aged fifty plus in eleven European countries. They argue that there is a significant association between individuals' cognitive abilities and their stockholding in terms of both direct stockholding and indirect market participation through mutual funds and retirement accounts.

Guiso, Sapienza, and Zingales (2008) argue that there is a negative effect on individuals' stock market participation rates which arises from a general lack of trust. Less trusting individuals avoid investments fearing that they may be 'cheated'. They also find a significant relationship between country specific characteristics in respect of 'trust' and limited stock market participation nationally.

Van Rooij, Lusardi, and Alessie (2011) investigate the effect of individuals' financial literacy on their financial decision-making. They submit questions to the Dutch National Bank Household Survey (DHS) which evaluate individuals' basic financial knowledge including numeracy, inflation and interest rates, as well as more

advanced financial knowledge relating to market instruments such as stocks, bonds, and mutual funds. They find a significant positive relationship between high financial literacy and stock market participation rates.

There are several studies which elicit individuals' expectations of stock market returns based on survey responses in order to explain their stockholdings (Vissing-Jørgensen, 2003; Dominitz and Manski, 2007). Following the arguments of Hurd (2009) and Manski (2004), the studies of Hurd, Van Rooij, and Winter (2011) and Kézdi and Willis (2009) support the proposition that individuals' or households' beliefs about future stock market returns have a fundamental influence on the forward-looking economic models which they apply in their investment decision-making.

Despite the homogeneous expectation assumption of the Capital Asset Pricing Model (Sharpe, 1964; Lintner, 1965), whereby investors apply the same economic model in forming their expectations as to trade-offs between return and risk, these studies develop the notion that investors' expectations are heterogeneous. The rationale is based on the argument of Hong and Stein (2007) who claim that disagreements among investors arise due to them applying different economic models. These models lead their interpretations to diverge from each other, despite simultaneously available public information. Hurd (2009) similarly posits that heterogeneity in beliefs is due to investors accessing and processing publicly available information differently from each other, rather than as a result of them holding private information.

Similarly, Dominitz and Manski (2011) investigate the beliefs of US individuals as to equity returns, for one year ahead, in probabilistic terms. They define the population by their expectations types as described in finance literature; *random-walk (RW) type*, individuals who employ historical market returns to predict future returns since such individuals believe that stock returns are independent and identically

distributed over time; *persistence* (P) *type*, who predict that recent stock price movements will persist in the near future; and *mean-reversion* (*MR*) *type*, who expect a reversion of the current stock market direction in the near future. Dominitz and Manski (2011) determine which category individuals fall into by looking at the relationship between individuals' expectations and market returns. Individuals of the RW type should be invariant to recent stock market performance and should exhibit persistent expectations over time; after higher market returns, the P type should reveal higher forecasts of future returns, while the MR type should generate lower forecasts for future returns. Dominitz and Manski (2011) find that the central tendency of their expectations takes the form of persistence; however, they argue that individuals may apply different models through time, and that examining only the central tendency is inadequate as a means of understanding the 'full story' of how individuals form expectations.

Based on their overall findings, Dominitz and Manski (2011) argue that individuals undertake '*interpersonally variable'* but *'intrapersonally stable'* processes when forming their expectations. They argue that the heterogeneity of individuals' expectations varies systematically with gender, age, and schooling, and is stable over time. Furthermore, these specific demographic effects do not affect the way that different individuals (RW, P, and MR) revise expectations as the scale of these demographical clusters is similar across the three expectation types.

In response to the stockholding puzzle of Haliassos and Bertaut (1995), Vissing-Jørgensen (2003) analyses investors' beliefs and their actions based on the household level data collected by the USB/Gallup monthly telephone surveys which were undertaken with over 1,000 investors for each month from June 1998 to December 2002. Vissing-Jørgensen (2003) finds that investors' beliefs are correlated with their investment choices. Investors who expect higher stock returns hold higher proportions

of equity in their portfolios, thus suggesting that understanding beliefs is in fact useful for the understanding of prices.

Dominitz and Manski (2007) measure the beliefs of US households about equity returns for one year ahead in probabilistic terms, and compare these with their portfolio choices. Highlighting the popularity of 'life-cycle' funds in the US, they challenge the life-cycle investment strategy whereby individuals' risk preferences vary systematically with age. They suppose that individuals adopt a more conservative approach to stock holding as they become more risk-averse with age, and that this systematic pattern should apply similarly to their expectations. Their argument contrasts with those of Merton (1969) and Samuelson (1969), who both discern a consistency in individuals' level of risk-aversion as well as in their optimal portfolio allocation.

Dominitz and Manski (2007) find substantial heterogeneity in individuals' reported beliefs; individuals hold more conservative investment portfolios as they age due to their pessimistic views on future equity returns; men are more aggressive in forming their expectations as they are more optimistic about the stock market than are women. Marital status matters for decisions to participate in the stock market as, in the case of married individuals, decisions are made by two individuals with higher wealth than single investors, other things being equal. Dominitz and Manski (2007) argue that systematic disparities between individuals as to expected returns are reflected similarly in the respective stock holdings of these individuals.

Furthermore, Dominitz and Manski (2007) consider the substantial proportion of households who hold no risky assets. They believe that those who do not hold risky assets distrust the existence of an equity premium. Under the standard two-asset model, risk-averse individuals will invest in risky assets only if their subjective means of stock market return expectations exceeds the risk-free rate. Dominitz and Manski (2007)

conclude that the probability of holding stocks increases with households' perceived increases as to future stock returns.

Hurd *et al*., (2011) also conclude in their study that individuals' pessimistic views on the stock market, together with their perceptions as to the risks of holding stocks, explain the stock holding puzzle sufficiently without any need to invoke very high levels of risk aversion. However, based on the argument of Haliassos and Bertaut (1995), heterogeneity in belief does not appear to explain the stockholding puzzle, as they state in their paper that:

Heterogeneity of opinions is not promising, since what is required is the perception that a premium exists, not that it is of a particular magnitude (pp.1114).

The motivation of Chapter Four derives from the difference in understanding between the current literature which argues that heterogeneous stock market expectations alone explain the stockholding puzzle adequately, and the concern raised by Haliassos and Bertaut (1995), to the effect that it is crucial to identify whether investors hold the *perception that a premium exists*. Individuals may face the same risk-free rate in the market, while perceiving the uncertainty over equity returns differently from each other since they implicitly employ both different risk measures and different benchmarks (Veld and Veld-Merkoulova, 2008). In particular, Barsky, Juster, Kimball, and Shapiro (1997) and Kapteyn and Teppa (2011) both recognise that the heterogeneous effects of risk aversion significantly determine individuals' portfolio allocation decisions.

Chapter Four presents a study which identifies the variations in individuals' perceptions over future stock returns by investigating the effect of individuals' risk aversion in explaining their stockholding decisions.

2.3.2 Biases in Individuals' Expectations Formation

The process by which individuals form their expectations is a fundamental component in any economic choice model. In the stock market, particularly, where many different individuals interact while seeking to achieve their own personal objectives, knowledge of how others form their expectations is crucial.

In contrast to the rational expectations arguments fundamental to standard economic theories, the behavioural finance approach builds on cognitive psychology theories grounded in the extensive experimental evidence demonstrating that investors' expectations are far from rational (Thaler, 1999a). Investors often put too much weight on the latest information, and put too little weight on the base rate, e.g. the historical average; in consequence, they tend to overact to instant market changes (De Bondt, 1993; 1998). Such behaviour is encapsulated by Tversky and Kahneman (1971; 1974) in their definition of *'representativeness heuristic'*. The effect of a *heuristic* is described as follows:

People rely on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations. In general, these heuristics are quite useful, but sometimes they lead to severe and systematic errors (Tversky and Kahneman, 1974 p. 1124).

Hirshleifer (2001) argues that many investors often implement rules-of-thumb, and exhibit heuristic biases due to limited time and cognitive resources. Similarly, De Bondt (1993) and Shleifer and Summers (1990) argue that stock prices are not driven solely by economic fundamentals, but rather by 'trend chasers', and investors' systematic misperception of market values. De Bondt (1993; 1998) finds that investors' general predictions as to the direction of share price movements in the near future are influenced by the most recent price changes. Investors become bullish in respect of

their expectations as to future market returns following a rise in the market index, and become bearish after the index falls. The impact of index movements is larger when these are more recent. De Bondt (1993; 1998) concludes that unsophisticated investors expect perceptible trends in prices to continue, naively extrapolating from past price trends. This spectacle has been configured as the *extrapolation bias*, which is an application of the *representativeness heuristic* (Tversky and Kahneman, 1974) in cognitive psychology which encapsulate the tendency of individuals to put too much weight on the most recent history, while failing to place sufficient weight on information derived from the broader picture of history, and what it represents. Such individuals are vulnerable to the latest news and forgetful of base-rate information.

Arrow (1982) states that the effect of *extrapolation bias* precisely typifies the excessive reaction to current information in the stock market as identified within excess security prices volatility patterns. Economists, however, argue that judgment errors are applied independently by individuals, thus cancelling out in equilibrium. If such heuristics are shared by most people, the popular models which individuals apply in forming their expectations are not the same as the oversimplified expectation models proposed by economists (Shiller, 1990). The variability of people's expectations of future events is, in fact, less than the true variability, contrasting with the Bayesian normative approach (Tversky and Kahneman, 1971; Kahneman and Tversky, 1972). Thus, the fundamental axioms of rationality are often violated by individual investors, and their violations are systematic, thus supporting the 'bounded rationality' models proposed by Simon (1982).

De Bondt (1993), however, observes contrasting results in the forecasts obtained from 'experts' in financial markets and from novices, respectively. Experts tend to predict negative returns after bull markets and unusually large positive returns after

bear markets. The majority of experts expect large price reversal, which is consistent with the views of intuitive contrarians, who believe in stock price mean-reversion. This result contrasts with Welch's (2000; 2001) findings based on surveys with 226 finance professors, in that he demonstrates that even experts are vulnerable to extrapolation bias. Welch (2000) asks these professors to predict the equity risk premium during the bull market between 1997 and 1998, and they predict that over the next 30 years, the equity risk premium will be 7.2% on average. After experiencing the market crash in 2000, Welch (2001) asks those professors the same question again, this time identifying an average predicted equity premium of 5.5%. Nevertheless, these professors indicate within the survey that they believe that market returns follow a mean-reverting process.

The effects of *extrapolation bias* in individuals' expectations as to future financial variables are found in other literature. Shiller (1990) argues that investors, and also home owners in the market, appear to extrapolate from recent past price trends by means of their short-term memory alone, failing to learn from their long term past experiences. Based on his studies on the US and Japanese stock market crashes in October 1987, as well as on real estate 'booms' in the US**,** he finds that individuals in 'boom' cities believe that large price increases experienced during the preceding year will continue indefinitely. Thus, he argues that extrapolation bias is a key feature underpinning the popular models shared by most investors. Furthermore, strikingly different results are found across cities demonstrating that extrapolation bias is a phenomenon which is independent of local markets, but dependent on the different experiences of individuals. He concludes that the experience of a local real estate 'boom' inclines people to the use of a popular model that leads to such illusions.

In his survey on foreign exchange rate forecasts, Ito (1990) argues that market agents form 'bandwagon' expectations regarding the short-term future, although

stabilising their expectations in respect of the long-term future. This result has been reemphasised by De Bondt (1993; 1998) in suggesting that investors distinguish intuitively between temporary and permanent price movements. He supposes that investors' views in respect of the short-term exhibit static expectations, while for the long-term they tend to exhibit regressive expectations. De Bondt (1993; 1998) finds that his subjects' expectations as to company returns for the following year are positively related to realised market returns; expectations as to future returns for a ten year period, however, are more stable than expectations as to future returns for a one year period. Chan, Karceski, and Lakonishok (2003), and Lee, O'Brien and Sivaramakrishnan (2008) also find that investors' expectations as to company growth rates and operating performance exhibit a positive relationship with market movements. Similarly, Graham and Harvey (2001) conduct a survey study with chief financial officers (CFOs) and find the same results.

Ito (1990) also detects wide disagreements among respondents confirming significant 'individual effects' in that the responses of individuals are significantly different from those of other individuals. The distribution is long tailed and heterogeneous traits are extensively associated with individuals characterised by associations with specific industry groupings. For example, exporters are the most biased toward Yen *depreciation*, while individuals from trading companies and importers are the most biased toward Yen *appreciation*. Consequently, Ito (1990) defines these variations as due to individuals' 'wishful expectations'.

Das and van Soest (1997; 1999) reject the rational expectations hypothesis based on their investigation of Dutch households' subjective expectations as to future income changes. Das and van Soest (1997; 1999) find that households' expectations are heavily influenced by realised income changes in the past, i.e. individuals who have

experienced a reduction in income are more pessimistic than others, and *vice versa*. Furthermore, households' expectations are compared with realised income changes in the following year, and those who have experienced a decrease in income underestimate their future income substantially. Das and van Soest (1997) argue that, in general, there is a positive correlation between actual income level and expected income change. The age and labour market status of the head and spouse of households significantly affects household expectations. Furthermore, Das and van Soest (1999), based on their analysis of the panel dataset, find that expected income changes are significantly correlated with labour status, family composition and the perpetual income of households.

In addition to investigating stock market nonparticipation, Vissing-Jørgensen (2003) also investigates whether her evidence supports previously suggested behavioural asset pricing model assumptions and attempts to build a unified behavioural model explaining both short-term under-reaction and long-term over-reaction in asset-pricing on the basis of the psychology of representative investors. In particular, Vissing-Jørgensen (2003) focuses on whether wealthy investors exhibit behavioural biases which may explain non-standard beliefs and actions that are unlikely to be due to information or transactions costs.

Using a series of questions, she investigates investors' own investment past returns and their outlook as to their own future returns. She also analyses investors' perceptions about the current valuation of the stock market and their expectations as to its future valuation. Vissing-Jørgensen (2003) reaches the following conclusions: First, even wealthy investors expect high returns at the peak of the market, suggesting that their forecasts are strongly associated with preceding market returns. Second, most investors believe that the market was overvalued during the last two years of the dot-

com boom, although, despite this, only about 20% of investors believed that the market would decline over the next three-months or one year. Third, investors' beliefs in respect of future market returns are heavily dependent on their own past investment experience. This result suggests a version of *the law of small numbers* (Tversky and Kahneman, 1971; Barberis *et al*, 1998; Rabin, 2002), which refers to the decision bias reflecting investors' beliefs that their recent experiences represent the market pattern as a whole. Fourth, the dependence of beliefs on personal past portfolio performance is asymmetric, consistent with theories of *self-attribution bias* (Daniel *et al*., 1998). Investors who experience high returns tend to attribute the results to their own skills; however, when the opposite is experienced, this is simply attributed to misfortune. This argument also supports the notion that investors' overconfidence prevents them from formulating a realistic assessment of their own abilities. Vissing-Jørgensen (2003) emphasises that those expectations biases affect not only less wealthy, less educated, and less experienced investors, but also are strongly featured among high-wealth investors, thus creating a substantial pricing impact.

2.4 Summary and Conclusion of Literature Review

Individuals often suffer from judgment biases since they make their financial decisions based on mistaken 'intuitions' which are not adequately modified or predetermined by a more deliberate mode of cognitive operation, 'reasoning'. Previous literature on *Behavioural Finance* is based on the bounded rationality assumption of Simon (1982). According to De Bondt's (1998) 'sorry' picture of individual investors, their perceptions of asset prices and trading practices reflect various classes of anomaly. Many individual investors are short-term oriented, exhibiting excessive optimism or pessimism over time, and trade in suboptimal ways, holding undiversified portfolios

(De Bondt, 1993; 1998). Shiller (1990) similarly argues that individual investors tend to rely heavily on naïve patterns based on past price changes, holding 'popular models' of value.

Previous literature on the persistent equity premium (Mehra and Prescott, 1985) and the stockholding puzzles (Haliassos and Bertaut, 1995), indicates that standard finance theories based on investor rationality and market efficiency assumptions fail to live up to their predictions. Although stocks are likely to be attractive investments over the long-term, given their high average returns and low covariance with consumption growth, individual investors are reluctant to hold stocks due to the high risks which accompany the premium (Mehra and Prescott, 1985).

Benartzi and Thaler (1995) propose the notion of *Myopic Loss Aversion* (MLA) based on two psychological concepts; *loss aversion* and *mental accounting* as a response to the question of why, unless individuals' risk aversion levels are implausibly high, the average equity premium remains so high. The MLA arguments of Benartzi and Thaler (1995) are further supported by many previous experimental studies including Thaler *et al*. (1997), Gneezy and Potters (1997), Bellemare *et al*. (2005), Langer and Weber (2008) and Fellner and Sutter (2009), which argue that if investors evaluate and rebalance their investment portfolios infrequently, they will be more willing to hold stocks.

Previous literature on the effect of MLA is mainly based on experiments (such as Thaler *et al*., 1997; Gneezy and Potters, 1997; Bellemare *et al*., 2005; Langer and Weber; 2008; Fellner and Sutter, 2009). The thesis makes a novel contribution by evaluating the effects of MLA on investors' real investment allocations, obtaining information on individual investors. This approach is free from the limitations faced by experimental studies and identifies the true effects of MLA on real investors.

Individuals' stockholding decisions are also determined extensively by their distinct beliefs and preferences, which are often biased and, at the same time, heterogeneous. Thus individuals hold virtually independent financial portfolios from each other. In addition to many alternative explanations for the stock holding puzzle (Haliassos and Bertaut, 1995), including fixed entry or transaction costs (Vissing-Jørgensen, 2002; Haliassos and Michaelides, 2003); social interactions (Hong, Kubik, and Stein, 2004), cognitive ability (Christelis, Jappelli, and Padula, 2010), trust (Guiso, Sapienza, and Zingales, 2008), inertia (Bilias, Georgarakos and Haliassos, 2010) and financial literacy (Van Rooij, Lusardi, and Alessie, 2011; 2012), the arguments based on heterogeneity of investors' beliefs (Vissing-Jørgensen, 2003; Dominitz and Manski, 2007) are reviewed in-depth.

Previous literature finds that investors' beliefs as to future stock market returns are correlated with their investment decisions, thus supporting the notion that understanding investors' beliefs is crucial to understanding stock prices and that the heterogeneity of their beliefs is significantly correlated with their personal characteristics (Vissing-Jørgensen, 2003; Dominitz and Manski, 2007; Hurd *et al*., 2011). Previous studies on individuals' heterogeneous beliefs demonstrate a lack of emphasis on individuals' risk preferences. Consequently, to achieve comprehensive understanding of the close relationship between individuals' beliefs and preferences, the thesis considers the effect of risk aversion on individuals' stock market returns expectations. Further, this literature review chapter discusses previous research findings, supported by cognitive psychology theories, on individuals' violation of the rational expectations hypothesis. Understanding the process by which individuals form their expectations is fundamental to understanding how their financial decisions differ in the market where many different individuals interact.

Chapter 3 Myopic Loss Aversion and Stock Investments: An Empirical Study of Private Investors

Abstract

Myopic loss aversion was suggested by Benartzi and Thaler (1995) as the main explanation for the equity premium puzzle. We investigate the impact of myopic loss aversion on actual investment decisions of 400 Dutch individual investors, covered by the Dutch National Bank Household Survey. We find that higher loss aversion is associated with a lower share of investments in risky assets. The investors also tend to self-select relatively high evaluation frequency. The combination of short investment horizon and high loss aversion leads to significantly lower levels of risky investments, confirming the main prediction of the myopic loss aversion theory. The effect of myopia is strongest when both evaluation and rebalancing frequencies are high. We also find that less myopic individuals increase their investment over time, although this effect is unrelated to their loss aversion.

3.1 Introduction

Benartzi and Thaler (1995) first suggested that myopic loss aversion (MLA) could explain the equity premium puzzle of Mehra and Prescott (1985). Because the risk aversion levels of investors alone cannot explain the abnormally large equity premium, Benartzi and Thaler (1995) propose the MLA concept, which combines the behavioural concepts of loss aversion and mental accounting. MLA is the tendency of investors, who are loss averse and observe their intermediate losses frequently, to invest less in equities as a consequence. Using simulations, Benartzi and Thaler argue that if investors evaluate their portfolios annually, the size of the equity premium is consistent with parameters estimated in prospect theory (Tversky and Kahneman, 1992). Supporting this argument, the experimental studies of Thaler *et al*. (1997), Gneezy and Potters (1997), and Haigh and List (2005) find that when evaluation frequencies are reduced, subjects increase their investment levels in risky assets.

The concept of myopia was originally developed using portfolio evaluation frequency; however, Gneezy, Kapteyn, and Potters (2003) suggest rebalancing frequency as another important proxy for myopia. Consequently, several experimental studies have tried to disentangle the effects of evaluation and rebalancing frequencies, though their findings conflict to some extent. Bellemare *et al*. (2005) argue that evaluation frequency alone can determine the effect of myopia, while Langer and Weber (2008) find that rebalancing frequency is the only driving force. Fellner and Sutter (2009) conclude that both variables contribute to the effects of myopia. In addition, in a multi-period experimental setting, Fellner and Sutter (2009) show that their subjects have a clear preference for more frequent feedback and rebalancing.

Previous studies on MLA are mostly based on experiments, using students as subjects for investment allocation simulations. However, there are a number of reasons

why analysing the decisions made by real investors may be preferable to relying only on experimental results. First of all, the monetary returns from experiments are very small compared to the returns from real-life investment decisions. The implications of winning or losing a gamble in an experiment are almost negligible for the participants' lifetime expected utility. Secondly, awarding people a reward for their choices creates an endowment effect; this has been shown by Kahneman, Knetsch, and Thaler (1990) to distort the subjects' decisions. Thirdly, the subjects used in such studies (most frequently, undergraduate students) are often very different from the population of investors in terms of their experience, knowledge, wealth and demographics.

Finally, in real life, investors often have control over the important variables that are treated as exogenous in the experimental studies on myopic loss aversion. Fellner and Sutter (2009) show that, for example, giving the subjects control over their investment horizon and feedback frequency can change the observed effect of myopia on the investment choices. Thus the previous studies have been successful in identifying the existence of myopic loss aversion in laboratory settings. Nevertheless, we do not know with certainty whether these results would affect the decision-making processes of real investors.

In this chapter, we fill this gap by measuring myopic loss aversion for a representative cross-section of individuals, and testing its effects on their actual investments in risky assets[5]. Our second contribution is in explicitly accounting for the joint effects of myopia and loss aversion, rather than merely studying them in isolation. Examining these two effects together is important because the entire concept of myopic loss aversion is built on the interaction of loss aversion and myopia. To the best of our

[5] The only study that comes close to analysing these issues on real-life data is that of Dimmock and Kouwenberg (2010) who exclusively focus on loss aversion as an explanation for household portfolio choice. However, they do not address the effects of investors' myopia.

knowledge, this is the first empirical study of myopic loss aversion which incorporates the effects of both investors' myopia and loss aversion.

Following Benartzi and Thaler (1995), we define MLA as a combination of individual investors' levels of myopia and loss aversion. To measure the level of myopia, we survey investors on both their evaluation and rebalancing frequencies. We also include questions which identify investors' reference points and framing patterns in line with prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992). The survey results are combined with the annual Dutch National Bank Household Survey (DHS), conducted on the same individuals, which enables us to determine investors' loss aversion level based on their responses to hypothetical intertemporal questions. The DHS also includes information on investors' asset allocation, their background characteristics (income and demographic), and their subjective measures of risk aversion and time preference.

Our findings strongly support the myopic loss aversion effect in individual investment behaviour and suggest that the simulations results of Benartzi and Thaler (1995) are based on plausible assumptions, with a median investor in our sample evaluating her investment results quarterly, although rebalancing the portfolio less than once a year. This result is also in line with the experiment of Fellner and Sutter (2009), who find that most subjects display a strong preference for high evaluation frequency and a somewhat less pronounced preference for short investment horizons. We find significant negative effects of myopic loss aversion on the proportion of individual portfolios invested in risky financial assets. These effects are driven by both loss aversion and myopia factors. Among highly loss averse individuals, the combination of frequent evaluation and high portfolio rebalancing frequency leads to relatively low levels of investments in risky financial assets, supporting the laboratory findings of

Langer and Weber (2008). This result is also consistent with Fellner and Sutter (2009), who find that both evaluation and rebalancing frequencies play an important role in myopic loss aversion. When we investigate the changes in the share of portfolios allocated to risky financial assets, the effect of myopia dominates the influence of loss aversion on investors' decisions. Investors who evaluate their holdings less frequently tend to increase their holdings over time compared to those who check their performance at least monthly. The result whereby infrequent evaluations lead to an increase in risky investments over time stands after we control for the changes in the level of investments due to stock market fluctuations.

The remainder of this chapter is organised as follows. In Section 2 we discuss previous literature in the area of MLA and introduce our main hypotheses. In Section 3 we explain our survey data collection procedure and provide details on how our variables are constructed. In Section 4 we present the models and empirical results of the study. Finally, we summarise and conclude our study in Section 5.

3.2 Literature Review and Research Hypotheses

The equity premium puzzle of Mehra and Prescott (1985) focuses on the abnormally high difference between the returns on the S&P 500 and default-free Treasury bills in the US between 1889 and 1978. The historical average equity premium of 6% is too high to be justified by standard economic models, unless there is an implausibly high level of risk aversion among investors.

As an answer to this puzzle, Benartzi and Thaler (1995) propose the concept of myopic loss aversion (MLA), which describes the tendency of loss averse investors to evaluate their portfolios too frequently and consequently to invest too little in risky assets. This notion is based on two behavioural concepts, loss aversion and mental

accounting; these are fundamental to the prospect theory of Kahneman and Tversky (1979) on decision-making under uncertainty.

Benartzi and Thaler's (1995) simulations show that to make the size of the historical equity premium consistent with the theory, an investor should evaluate his portfolio annually, and that an equal proportion of stocks and bonds would maximise his prospective utility. Experimental studies have supported their argument. Thaler *et al*. (1997) replicate a series of investment allocations between two assets, which differ in risk, such as stocks and bonds. Their results confirm that the subjects who are under the less frequent evaluation condition invest a higher proportion in stocks than those who evaluate their investment results more frequently. They also create a situation of high inflation, by adding a constant to the returns of stocks and bonds, thus ensuring positive returns. The results reveal that subjects, who do not observe losses, substantially increase their preference for stocks, thus exhibiting money illusion (Shafir, Diamond, and Tversky, 1997).

Gneezy and Potters (1997) find that if subjects are restricted in investment adjustment, they are less inclined to evaluate outcomes anxiously, thus preventing them from withdrawing their investments over occasional setbacks. Undertaking the same experiment as Gneezy and Potters (1997), both Haigh and List (2005) and Eriksen and Kvaløy (2010) find that the adverse effects of MLA are observed to an even higher extent among professional traders and financial advisors than they are among students.

Similarly, Sutter (2007) manipulates the study of Gneezy and Potters (1997) in order to compare investment decisions between teams and individuals by forming three individuals into one team. He finds a persistent influence of MLA on the decisions of teams; although teams' decisions exhibit attenuated MLA by making much higher

investments than individuals, they are still prone to MLA. He concludes that MLA is a valid explanation for the equity premium puzzle regardless of types of decision maker.

Gneezy, Kapteyn and Potters (2003) add market interactions to their experiments, allowing their subjects to buy and sell an asset freely by submitting bids and offers. They observe that the frequency of rebalancing a portfolio affects the asset prices in the same way as evaluation frequency, which was initially considered as the only driving force of myopia. Subsequently, a number of experimental studies have tried to disentangle the effects of evaluation and rebalancing frequencies.

Bellemare *et al*. (2005) follow the experimental approach of Gneezy and Potters (1997), but divide the subjects into three groups to disentangle the effect of evaluation frequency from that of rebalancing frequency. They conclude that the effect of myopia can be explained by evaluation frequency alone.

Langer and Weber (2008) similarly disentangle the evaluation period from the rebalancing period by dividing their subjects into four categories. They also employ a multiplicative approach in which an investor can transfer his initial endowment from period to period, and reinvest their returns. They argue that there is a significant effect only from the rebalancing frequency and that the effect of the low rebalancing frequency is stronger when the evaluation frequency is high.

Fellner and Sutter (2009) determine that both variables influence investment behaviour. Taking the time pattern of investment behaviour into account, they find positive results when at least one of these variables is at a lower frequency. The investments in a risky lottery by their subjects are highest under conditions of low rebalancing frequency combined with high evaluation frequency or of high rebalancing frequency with low evaluation frequency. Additionally, they allow endogenous choices regarding the levels of frequencies for a subgroup of their subjects. Since the majority

prefer high frequency conditions, they include a novel intervention, informing subjects of a higher average payoff from the low frequency conditions to encourage them to switch to the more rewarding regime at a small cost. They do not achieve a strong shift in subjects' preferences, but their intervention is still partially successful as a large proportion of their subjects at the low frequency conditions retain this frequency to avoid the charge. Fellner and Sutter (2009) argue that the subjects who made endogenous choices are less negatively affected by MLA than those who were exogenously divided into varying levels of frequency conditions.

Most experimental studies on MLA endeavour to overcome the limitations arising from the artificial set-ups. For example, Gneezy *et al.* (2003) enhance their experiment by adding market interactions while Langer and Weber (2008) apply a multiplicative approach in which subjects can transfer their initial endowment over periods and reinvest their returns. Fellner and Sutter (2009) introduce endogenous choices as to levels of frequencies by their subjects to embody more realistic circumstances. Although most studies have tried to provide the most realistic conditions for their subjects, it is difficult to incorporate real market conditions in experiments. Most studies conduct their experiments with students, except a few which include professional investors, such as Haigh and List (2005) and Eriksen and Kvaløy (2010). Additionally, subjects are usually exogenously assigned their experimental conditions. To overcome these limitations, in this study we use survey results of individual investors to study the effects of MLA on their actual portfolio allocation decisions.

Based on the arguments of Benartzi and Thaler (1995; 1999), and Thaler *et al*. (1997), we suggest the following hypothesis.

Hypothesis 1: *Individuals who are less affected by MLA invest more in risky financial assets.*

Thaler *et al*. (1997) acknowledge that their experiment provides the subjects with a learning opportunity, as they monitor the performance of different assets in terms of their risk and return through the experiment. Individuals who participate in the market also experience the history of the market and the utility derived from their decisions. In practice, those investors who frequently evaluate their portfolio returns have a higher chance of facing losses. The more loss averse such investors are, the greater the level of disappointment they experience from investing in risky financial assets, and therefore, they are more likely to reduce their holdings over time. Thus the second hypothesis is:

Hypothesis 2: *Individuals who are less affected by MLA increase their holdings in risky financial assets over time relative to those highly affected.*

3.3 Data Description and Construction of Financial Variables

3.3.1 Sample Selection

We use the survey data from the CentERdata panel, a specialised online research institute at Tilburg University in the Netherlands. It consists of over 2,000 households including individuals over 16 years, representative of the Dutch population with regard to a number of important demographic characteristics. This panel has been extensively involved in academic research; for instance, Van Rooij, Lusardi, and Alessie (2011; 2012) use it to study the effects of financial literacy on individual stock market participation and wealth, Dong, Robinson, and Veld (2005) study the preferences of individual investors on dividend payments, and Guiso, Sapienza, and Zingales (2008) investigate the relationship between trust and stock market participation based on the data from this panel.

Table 1 Sampling Process and Demographic Background

Panel A - Sampling Process

The following table presents the sampling process of this study.

	Remained	Lost
Total number of individuals contacted on behalf of our survey	2,226	-
Individuals who were able to answer investment related questions in our survey	687	1,539
After merging the dataset with the hypothetical intertemporal questions	407	280
After merging the dataset with risk aversion and time preference questions	403	4
After merging the dataset with questions on assets and liabilities	**400**	3

Panel B - Demographic Background of Individual Investors

The following table presents the demographic backgrounds of 400 individuals in our sample.

Gender	Men	68.3%	**Education**	Secondary Education	43.3%
	Women	31.8%		College or University	56.8%
Marital status	Single	20.5%	**Occupation**	Regular employment	54.8%
	Married	79.5%		Self-employed	12.8%
				Retired	24.5%
Age	30s and Less	20.3%		Others	8%
	40s	26%			
	50s	21.3%			
	60s	17.5%			
	70s and more	15%			

Panel C - Financial Information

The following table presents the ownership rate, defined as the percentage of individuals who hold risky financial assets, and descriptive statistics of the share invested in risky financial assets from individuals' total financial assets (SRFA), and its breakdown between shares and mutual funds. The AEX index total return is the average annual return over the sample period, including reinvested dividends.

	Stats.	Ownership %	SRFA %	Mutual	Share %	AEX Return
	Mean	59.39%	23.38%	59.78%	39.18%	8.45%
	Median		6.95%	85.39%	12.19%	
N = 3347	Std.		29.68%	43.94%	43.55%	

Panel D – Descriptive Statistics on Financial Assets

The following table presents the descriptive statistics including mean, median and standard deviations of stock, mutual funds, risky financial assets, total financial assets, total assets, financial debts, and total debts in Euros for each year over the sample period.

Year	€ Stat.	Stock	Mutual Funds	Risky Financial Assets	Total Financial Assets	Total Assets	Financial Debts	Total Debts
1997	Mean	15,753.89	7,448.69	23,202.58	45,245.82	150,885.70	2,238.96	32,827.48
N=145	Median	0.00	0.00	2,042.01	16,174.85	118,005.50	0.00	5,899.14
	S.D.	64,042.51	16,487.30	71,841.24	88,157.12	156,906.50	6,817.08	50,690.94
1998	Mean	22,176.92	11,604.15	33,781.07	52,786.30	190,431.60	2,253.65	36,669.24
N=145	Median	0.00	0.00	3,305.79	15,700.79	139,401.20	0.00	23,596.56
	S.D.	87,852.07	24,614.87	99,725.78	114,511.80	346,686.00	7,701.56	60,006.26
1999	Mean	19,594.54	12,683.44	32,478.49	49,815.55	114,495.90	2,920.45	25,496.94
N=160	Median	0.00	0.00	4,084.02	16,046.80	52,236.67	0.00	0.00
	S.D.	86,612.18	33,703.39	114,339.20	130,258.50	162,941.20	18,057.38	56,774.17
2000	Mean	10,943.89	10,838.90	21,831.06	43,062.34	164,179.80	1,774.76	28,628.95
N=220	Median	0.00	0.00	2,061.07	19,422.92	91,378.23	0.00	84.86
	S.D.	48,120.83	32,096.91	71,677.85	81,356.26	201,463.40	5,946.07	50,427.47
2001	Mean	14,808.07	14,819.66	29,790.06	70,032.32	210,256.00	2,489.08	38,158.36
N=279	Median	0.00	907.56	3,630.24	29,041.92	147,106.70	0.00	2,059.31
	S.D.	71,081.16	43,447.65	99,311.60	184,823.90	291,892.80	11,886.20	57,974.15
2002	Mean	10,989.77	13,092.21	24,541.12	71,953.65	255,469.00	3,522.29	54,263.33
N=297	Median	0.00	1,134.45	4,855.45	32,822.36	192,605.30	0.00	13,160.07
	S.D.	47,631.92	36,317.94	66,331.18	114,366.70	257,031.60	23,874.68	93,664.43
2003	Mean	8,012.15	9,177.44	17,411.40	72,018.64	260,270.60	5,783.86	58,779.35
N=315	Median	0.00	0.00	492.00	32,082.82	226,236.50	0.00	21,360.00
	S.D.	27,919.99	34,872.34	48,984.78	159,083.20	289,044.00	36,266.11	97,013.10
2004	Mean	9,674.27	9,932.91	19,826.75	86,468.17	273,985.30	2,716.01	55,868.38
N=297	Median	0.00	0.00	1,000.00	38,169.19	226,643.00	0.00	15,000.00
	S.D.	33,773.54	37,124.08	53,586.90	251,144.20	358,096.70	17,030.51	80,860.02
2005	Mean	9,595.49	**12,755.74**	22,406.57	85,369.43	287,397.10	2,326.61	58,587.29
N=270	Median	0.00	0.00	1,895.00	39,100.00	250,830.00	0.00	30,500.00
	S.D.	31,644.72	41,683.44	56,631.94	190,774.30	318,104.40	13,603.85	77,742.50
2006	Mean	12,185.72	17,149.47	29,370.47	87,750.40	299,566.00	996.42	56,191.85
N=274	Median	0.00	0.00	1,808.00	39,631.50	253,714.80	0.00	21,405.20
	S.D.	45,747.04	45,687.93	75,373.91	131,457.30	273,400.00	7,105.93	76,459.73
2007	Mean	11,982.70	18,114.85	30,111.53	99,037.26	343,356.20	1,688.74	67,024.59
N=270	Median	0.00	0.00	968.50	42,308.00	280,322.00	0.00	28,200.00
	S.D.	46,552.48	46,433.69	78,959.94	205,975.90	357,695.10	8,766.30	94,767.50
2008	Mean	13,401.06	24,457.35	37,872.99	112,928.30	371,219.40	1,001.66	72,406.66
N=246	Median	0.00	0.00	1,325.00	41,874.61	299,347.00	0.00	24,750.00
	S.D.	76,479.33	99,156.79	164,600.70	335,561.80	459,853.80	5,132.49	113,363.50
2009	Mean	8,290.50	18,202.10	26,531.97	83,535.37	330,331.60	2,874.27	69,403.94
N=226	Median	0.00	0.00	1,700.00	37,134.30	284,446.70	0.00	14,500.00
	S.D.	42,689.81	67,603.51	84,930.40	167,539.30	330,640.70	18,158.42	112,705.60
2010	Mean	7,597.64	16,171.69	23,769.32	85,294.66	341,252.00	1,785.73	74,145.07
N=203	Median	0.00	0.00	825.00	38,003.48	300,600.00	0.00	26,000.00
	S.D.	51,579.86	61,718.81	81,534.51	177,365.80	319,707.30	11,160.74	110,633.10
Total	Mean	18,496.30	19,654.51	38,351.09	103,404.10	351,509.40	3,706.51	70,816.32
N=3347	Median	0.00	0.00	2,500.00	42,204.20	265,126.00	0.00	14,580.00
	S.D.	97,007.28	64,279.28	136,317.00	241,328.80	438,646.00	24,919.09	118,139.70

In 2003, we submit a special survey on MLA to the CentERdata panel and 2,226 panel members participated. Since the survey questions focused on investors' portfolio evaluation and rebalancing frequencies, as well as on their relevant reference points and framing patterns for the evaluations, only those who invest in risky financial assets (stocks and mutual funds) had the ability to answer.[6]

From those 2,226 individuals, we obtain responses from 687 investors, which indicate that about 30% of the contacted panel members are investors. This percentage is comparable to the equity ownership rates in the Netherlands reported by Alessie, Hochguertel, and van Soest (2004) and by Dimmock and Kouwenberg (2010). We combine the special survey on MLA with the annual Dutch National Bank Household survey (DHS) which includes extensive financial, demographic and psychological information. The DHS survey has been undertaken by the panel since 1993. From the *Economics and Psychological Concepts* section of the DHS, we select questions which enable us to estimate the loss aversion, discount rate, and risk-aversion, of individuals as well as their time preferences. We discuss these questions in more detail in the following sections.

We first merge the survey with the inter-temporal choice questions from the DHS which enable us to estimate individuals' loss aversion levels and discount rates. These questions are available for the period 1997-2002. Due to the removal of these questions from 2003, a large number of missing values is generated, resulting in a reduction of the sample size to 407. We further incorporate the risk-aversion and time preference questions from the DHS for the year 2003. For the resulting additional 5% of missing values, we impute values reported in the years 2002 and/or 2004 for the same individuals, but we do not have these data for 4 individuals. Finally, we merge

[6] In this paper, we investigate the relationship between the effect of myopic loss aversion and individual investors' portfolio allocation decisions according to the theory suggested by Benartzi and Thaler (1995). Thus, the question of what determines stock market participation falls outwith the scope of the study.

our dataset with the assets and liabilities section of the DHS for the period 1997 (the first year for which the inter-temporal questions are available) to 2010, making 14 years of asset allocation data in total. We lose a further 3 individuals who failed to report their assets and liabilities over the period. In Panel A of Table 1, we present our sample selection process and in Panel B we show the demographic characteristics of our sample in 2003.

Our unbalanced panel includes 400 individuals who appear on average for 8 years, making a total of 3,347 observations for the period from 1997 to 2010. With respect to the 400 individual investors' demographical characteristics, 70% of these are men and about 30% are women. Their ages range from 20 to 88, with an average age of 52. About 80% of them are married. 57% have either a college or university education. Our sample, including investors only, is more representative of actual stock market investors, and is thus biased towards older, married, better educated male respondents. We believe that it is, therefore, more suitable for investigating the effects of MLA than the randomly selected samples of previous experimental studies.

3.3.2 Financial Variables and the Market Performance

We incorporate the aggregated assets and liabilities values from the annual DHS from 1997 to 2010. All financial values are as at 31st of December of the preceding year. Following Alessie, Hochguertel, and van Soest (2000), we define *Total financial assets* as the sum of positive balances on *Checking accounts, Employer sponsored savings plans, Savings accounts, Deposit books, Savings certificate, Single-premium annuity insurance policies, Savings and endowment insurance policies, Mutual funds, Bonds, Stocks, Options, Money lent to friends and family, and Other savings or investments*.[7]

[7] Different types of assets and liabilities available from the DHS are discussed in detail by Alessie, Hochguertel, and van Soest (2000).

Employer sponsored savings plans are a unique asset class in the Netherlands, designed to encourage employees to participate in wealth accumulation, and introduced by a political compromise between unions, employers and the government in the early nineties (Alessie *et al.*, 2000). Individuals report the total amount held in their *Employer sponsored savings* account only if they participate in a 'save-as-you-earn deduction arrangement' which automatically deposits a certain amount from their gross salary in a separate savings account. In the Netherlands, the total saved amount is subject to neither income tax nor premiums for social insurance policies. Each year, employees can save up to €613 (reduced in 2011 from €788 which applied during 1995-2010). In order to be entitled to future tax benefits on withdrawals, however, no money may be withdrawn during the first four years (DNB Household Survey 2011 codebook).[8] Although this scheme is less liquid than ordinary savings accounts, it is much more tax favoured.

As a common form of defined contribution (DC) pension plans, *Single-premium annuity insurance policies* involve a one-time premium payment which is tax deductible. If individuals had taken out the insurance and if it is still in effect, they report the amount of the guaranteed minimum final payment. Individuals only report if they hold these policies separately from employer-sponsored savings plans or professional pension plans. Most Dutch employees are covered by mandatory defined benefit (DB) pension plans, thus the participation rate in such voluntary insurance policies is much lower than for any other European country (Alessie *et al.*, 2000). Individuals also report the total amount saved on their *Savings and endowment insurance policies*. As a form of life-insurance, endowment insurance policies are known as 'insured saving', providing a lump sum at maturity rather than an annuity.

[8] The DHS codebooks are available at the CentERdata website. For more information, please follow the link: http://cdata3.uvt.nl/dhs/files/CodebookWave2011English.pdf

Although the premium payments are not tax deductible, the lump sum is. Some of these life insurance policies are also linked to a mortgage.

Pension wealth accounts for a considerable part of total household wealth in the Netherlands as most Dutch employees are entitled to mandatory occupational pension schemes. However, we are unable to obtain reliable information from the DHS, which fails to capture the details of mandatory occupational pension investments held by households. Consequently, we are unable to identify the true level of risky financial assets held by individual investors. In addition, although non-mandatory pension savings are defined within the financial asset categories in the forms of life and annuity insurance, they are rather broadly defined (Alessie *et al.*, 2000). To obtain better understanding of the pension system in the Netherlands, and the consequential investment decisions of Dutch individual investors, we discuss the pension system in the Netherlands in further detail in the following section.

Risky financial assets are calculated as the sum of *Individual company shares* and *Mutual funds*[9]. Our main variable of interest is the Share of Risky Financial Assets (hereafter SRFA), which is defined as the percentage of individuals' total financial assets which is invested in risky financial assets. The SRFA value is comparable to the endowed capital allocated to risky gambles in experimental studies.

In Panel C of Table 1, we present average risky asset ownership rates, measured as the percentage of individuals holding risky financial assets over our sample years. These rates are below 100% since we observe that individuals in our sample tend to exit and re-enter the equity market from time to time. Descriptive statistics for the SRFA,

[9] We do not include *Options* or *Bonds* in the risky financial asset category, due to their different characteristics, and the possibility of hedging. If individuals hold any put or call options, they report the total amounts that they had paid for when they had bought them or the total market value when they had written them. *Bonds* are often reckoned as riskless assets in the Netherlands, and in our data from the DHS, the length or type, e.g. whether they are issued by the government or private companies, are not distinguished. Alessie *et al.* (2000) identify that *Bonds* are an unpopular type of asset in the Netherlands, in contrast to other European countries.

the proportion of *Shares* and *Mutual funds* in the SRFA, and the average total annual return on the main Dutch stock market index AEX, are also reported.

In Panel D of Table 1, the descriptive statistics including mean, median and standard deviations of stock, mutual funds, risky financial assets, total financial assets, total assets, financial debts, and total debts are reported in Euros for each year over the sample period. We winsorise all financial variables, by means of replacing all observations in the top percentile at the value of the 99th percentile. Thus, we can prevent any outliers affecting our results.

To control for the credit constraint of individuals, which can influence investors' investment capability (Cocco, 2004; Cocco, Gomes and Maenhout, 2005), we create a debt ratio taking account of individuals' total debts to total assets. *Total assets* comprise financial assets and fixed assets including *Real estate, Owners' houses* and the *Cash value of insurance on real estate and owners' houses*. In the debt category, there are *Negative current accounts balance, Private loans, Extended lines of credit, Debts with mail-order firms, Loans from family and friends, Student loans, Credit card debts,* and *Other debts,* as well as *Mortgages for real estate and owners' houses*.

Household wealth is largely invested in the house as a non-financial asset. Simultaneously, the majority of home-owners hold one or more mortgages. The decreasing trend in mortgage interest rates, which is also fully tax-deductible, has increased demand for housing ownership (Alessie *et al.*, 2000). Mortgages on real estate investment and a second house are, however, not tax deductible, which makes them less popular. As with other countries, house prices in the Netherlands are highly sensitive to economic and political changes. The Dutch housing market was also affected by the global financial crisis in 2008, experiencing a fall in national median

price of 13% (14% in real terms) from 2008 to 2009,[10] after the relatively long house price boom over 1992-2007. Consequently, not only investors' investments in real estate, but also their own houses are liable to be risky assets regarding uncertain price movements. The DHS, therefore, asks households to report the market value of their real estate investments including their own houses.

Alessie, Hochguertel, and van Soest (2000) argue that the portfolio structures of Dutch households reflect institutional features including both mandatory pensions and tax systems. Individual investors tend to adopt investment strategies which optimally exploit the existing tax rules. Two important asset classes affecting individuals' savings and net worth, and closely connected to institutional plans, thus require further investigations are individuals' pension assets and their real estate investments. In the following section, we discuss the nature, size and tax incentives related to pension savings and real estate investments including owner-occupied housing in the Netherlands. These two asset categories are important in relation to individual investors' decisions on whether to invest in other or risky assets.

3.3.3 Pension Savings and the Housing Market in the Netherlands

Both pension savings and housing are important asset classes to individual investors in ensuring their financial stability after retirement. The pension saving schemes and housing plans held by individual investors directly influence their current savings, consumption, and net worth. It is important to discuss, therefore, the nature, size and tax incentives related to pension savings and housings in the Netherlands as the context for the current study.

[10] The Central Bureau of Statistics (CBS) reports that the median national house price was €225,000 during the second quarter of 2009. See more information from Global Property Guide (June, 2010) at http://www.nuwireinvestor.com/ articles/a-review-of-the-netherlands-real-estate-investment-market-55334.aspx

In the Netherlands, a mixture of public and private pension provisions is available under three main pillars: the first pillar is the state old-age pension as a statutory insurance scheme; the second pillar is a supplementary occupational pension scheme supported by employers; and the third pillar is individual saving schemes which are privately arranged by enrolling onto annuities or endowment insurance (Alessie, Kapteyn, and Klijn, 1997). The first pillar includes two forms, namely a General Old Age Pensions Act (AOW) and a Surviving Dependants Act (ANW). Regulated by law since 1957, the AOW is a public fund based on the pay-as-you-go system supported by tax revenues to provide a full pension right to those who are 65 and over. Individuals aged between 15 and 65 are insured by the AOW at an accumulating rate of 2% each year to ensure a 100% entitlement to the flat-rate benefit when reaching the age of 65. The AOW guarantees 70% of the minimum wage for singles, and 50% to each individual in a couple, if both are entitled (in 2011, the pension benefits were EUR 1,034 and EUR 711, respectively). At the end of 2010, the AOW pension benefits were provided to about 3 million people, at a cost amounting to EUR 30 billion in total. Housewives are also entitled to the AOW benefit when they become 65 even if they have never paid contributions. Similarly, the ANW is a flat-rate benefit available for the surviving partner or children after the death of the other partner or parents.[11]

The AOW provision accounts for only a small part of the joint capital of all pension providers which is over EUR 725 billion providing pension benefit or vested pension rights to about 8.5 million individuals (Dutch Central Bank Annual Report, 2007). The major part of pension provisions in the Netherlands is financed by the collective occupational pension at the second pillar. The occupational pension scheme

[11] This section summarises a document titled 'The old age pension system in the Netherlands' published by the Dutch Ministry of Social Affairs and Employment (June, 2008). More information on pensions in the Netherlands can be found at the website of the Dutch Ministry of Social Affairs and Employment: www.english.szw.nl (benefits/old-age pension).

is regarded as the best developed scheme in Europe and is characterised by quasi-mandatory participation covering more than 95% of employees, collective risk sharing, and the transfer pension value system. Each year, employees accrue about 2% of their salary for the pension right regardless of their age, gender or income, and the benefit is available from retirement, usually at 65, till death. In general, employers contribute more than 50% of the total. In the Netherlands, defined benefit (DB) plans dominate, covering about 85% of the occupational pension provisions, thus allowing employees to be exempted from financial or longevity risks. In 2010, most DB plans are based on average wage (91%), and DB plans based on final pay only accounts for 1% of the total compared to 59% in 2000. About 5% of employers currently offer a defined contribution (DC) plan (Whitehouse, 2003). Following the international trend to transfer investment risk to employees, more companies are anticipated to convert to DC plans. The new International Accounting Standards 19 (IAS), which requires the liabilities retaining to DB schemes to be reported on company balance sheets, also increased companies' preference for DC plans (Van Rooij, Kool, and Prast, 2007).

The third pillar is private pension schemes based on annuities and endowment insurance encouraged by partial tax reliefs. Self-employed individuals can arrange individual pension provision supplementary to their AOW benefits. Additionally, the annual special tax allowance is available to companies run by self-employed individuals deferring the tax payment over that amount. The general pension schemes are potentially subject to taxation at each of three stages: 1) when money is contributed to funds by either employers or employees; 2) when the funds accrue investment income or capital gains; 3) when pension benefits are taken by retired scheme

members[12]. There are international variations in the generosity of tax incentives for pension funds (Whitehouse, 2003). The tax treatment in the Netherlands is identified as an EET system, as at the first two stages contributions to the pension funds and also incomes are tax exempt (E), then benefits are taxed (T) at the last stage. Individuals are encouraged by the tax incentives to purchase annuity insurance in addition to their pension obligations. The generous tax legislation benefits investors by allowing lower marginal tax rates during retirement than employment (Whitehouse, 2003).

The government plays a significant role in the housing market in the Netherlands to the extent of land development and reclamation given that about 60% of the population are living below sea-level, as well as providing and controlling mortgage subsidies and the social housing sector. In the 1950s, owner-occupied housing constituted only 29% of the total residential figure, which largely consists of rented housing[13]. From the 1980s, home-ownership was promoted by the government with generous mortgage subsidies. For home-owners, mortgage interest is fully tax deductible and capital gains from house sales are not subject to tax. Residential mortgage debts reached almost 100% of GDP in 2008, and more than 3.5 million Dutch households, six out of every seven, had taken out a mortgage by 2009[14]. The total owner-occupied residential figure had increased from 42% in 1980 to 55% in 2011.[15] The total tax deduction amounted to about 33 billion Euros in 2011, a doubling since 2000[16]. Although it varies depending on the total income of households, a home-owning household saves 290 Euros on average (about a 13% reduction) per month from

[12] European Commission (2013), Taxation and Custom Union presents articles about pension taxation, find at : http://ec.europa.eu/taxation_customs/taxation/personal_tax/pensions/index_en.htm
[13] Detailed information is available at: http://www.nuwireinvestor.com/articles/a-review-of-the-netherlands-real-estate-investment-market-55334.aspx
[14] Statistics Netherlands Press release (March, 2010), Netherlands Housing Research 2009, http://www.cbs.nl/NR/rdonlyres/0D12FD2B-2272-4892-91A2-EA3F98DD860C/0/pb10e020.pdf
[15] Statistics Netherlands: http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=71446ned
[16] Statistics Netherlands Web magazine, titled 'Tax deduction home owners amounts to 33 billion euro', http://www.cbs.nl/en-GB/menu/themas/inkomen-bestedingen/publicaties/artikelen/archief/2012/2012-3676-wm.htm

their income tax and social insurance contributions. The government also provides grants to low-income households to help them towards home-ownership (Elsinga, 2003).

Since 2002, the Dutch government limits interest deductibility to 30 years to prevent excessive mortgage growth. If a home-owning household moves to a more expensive house, their down-payment is expected to be paid by their capital gains on their former house. Tax deductibility is also inapplicable to mortgages on real estate investments and second home-ownership since 2001. This change of the scheme is due to the exploitation of mortgage tax benefits which was prevalent during the nineties (Alessie *et al.*, 2000).

Both pension savings and home-ownership are extremely tax-favoured in the Netherlands. Compared to other countries, Dutch individual investors receive more institutional supports in terms of their asset management and wealth accumulation. It is, however, unfortunate that our dataset does not fully capture the insight of investments to be discussed together with their further investment decisions.

3.4 Results from the Survey Questions

3.4.1 Measuring the Level of Myopia

To define the level of myopia, we follow the design of Gneezy and Potters (1997), and also adopt the approach of Langer and Weber (2008), to disentangle the effects of the evaluation frequency from the rebalancing frequency, adopting a 2-by-2 design where both frequencies are divided into two levels, High and Low. Fellner and Sutter (2009) also support this design as the combination of both factors enables complete identification of myopia. In our survey, we ask investors about their evaluation and rebalancing frequencies following the ‘choice bracketing’ approach of

Read, Loewenstein and Rabin (1999), by providing 'daily', 'weekly', 'monthly', 'quarterly', 'annually', and 'less often than annually' options for both questions.

The question on the evaluation frequency is posed as "*How often do you evaluate the performance of your stock portfolio on average? An evaluation can take different forms. It can, for example, vary from including recent prices in a spread sheet to simply checking in newspapers or on Teletext*[17] *how the shares perform.*" The question of rebalancing frequency is posed as "*How often do you change your stock portfolio by buying or selling shares without the need for cash*?"[18]

Our survey results are presented in Table 2. We observe that individuals' evaluation frequencies are evenly spread from 'daily' to 'less often than annually'. 44% of individuals choose to evaluate their portfolio performance every month or more often. These frequencies of evaluation expose individuals to observing portfolio losses on a regular basis, which may be detrimental to their propensity to invest in risky assets and, therefore, to their aggregate wealth. Such choices are similar to the very strong preferences for frequent feedback found in the experimental study of Fellner and Sutter (2009).

In assessing rebalancing frequency, however, 70% indicate that they rebalance their portfolio less often than annually. Individuals in our sample opt for a low rebalancing frequency in contrast to the argument (Fellner and Sutter, 2009) that investors generally prefer high rebalancing frequency, and tend to over-trade due to their overconfidence based on the study of the discount brokerage accounts (Odean, 1999; Barber and Odean, 2000; 2001). Our results are more similar to Agnew, Balduzzi,

[17] Teletext is a data broadcasting service in which pre-programmed sequences of frames of data are broadcast cyclically.

[18] This question fails to deal with the fairly common 'regular' monthly investment in equities (or mutual funds).We acknowledge it as a limitation as there is room for ambiguity in the responses made by individuals to this question. However, the natural reaction would be probably not to regard these monthly contributions as 'rebalancing' of the individuals' actively managed portfolios.

and Sundén (2003), who find that individual investors in 401(k) plans also trade infrequently, as over 87% maintain their allocation for at least a year and, on average, they rebalance every 3.85 years. We divide both variables into high and low at their median values. For evaluation frequency, we allocate individuals from 'daily' to 'monthly' conditions to *High level* (44%) and from 'quarterly' to 'less than annually' to *Low level* (56%). For rebalancing frequency, we define frequencies from 'daily' to 'annually' as *High level* (30%) and define frequency of 'less than annually' as *Low level* (70%).

Table 2 Measuring the Level of Myopia

Evaluation Frequency
How often do you evaluate the performance of your stock portfolio on average? An evaluation can take different forms. It can, for example, vary from including recent prices in a spreadsheet to simply checking in newspapers or on *teletext* how the shares perform.

Frequency	Daily	Weekly	Monthly	Quarterly	Annually	Less often	Total
N	52	62	63	87	87	49	400
(%)	(13 %)	(15.5%)	(15.8%)	(21.8%)	(21.8%)	(12.3%)	(100%)
	High Level (44%)			**Low Level (56%)**			

Rebalancing Frequency
How often do you change your stock portfolio by buying or selling shares without the need for cash?

Frequency	Daily	Weekly	Monthly	Quarterly	Annually	Less often	Total
N	1	6	21	38	54	280	400
(%)	(0.3%)	(1.5%)	(5.3%)	(9.5%)	(13.5%)	(70%)	(100%)
	High Level (30%)					**Low Level (70%)**	

Groupings by the level of Myopia

	Frequency	Per cent
HEHR (High Evaluation with High Rebalancing frequency)	70	17.5%
HELR (High Evaluation with Low Rebalancing frequency)	107	26.8%
LEHR (Low Evaluation with High Rebalancing frequency)	50	12.5%
LELR (Low Evaluation with Low Rebalancing frequency)	173	43.3%
Total	400	100%

Consequently, we categorise 400 individuals into four groups, which allows us to disentangle the two variables, and assess the effect of varying levels of myopia. We allocate 70 individuals (17.5%) into 'High Evaluation with High Rebalancing frequency' group (HEHR); 107 individuals (26.75%) into 'High Evaluation with Low Rebalancing frequency' group (HELR); 50 individuals (12.5%) into 'Low Evaluation with High Rebalancing frequency' group (LEHR); and 173 individuals (43.25%) into 'Low Evaluation with Low Rebalancing frequency' group (LELR) as listed in Table 2.

3.4.2 Measuring Individuals' Loss Aversion Coefficients and Discount Rates

During 1997-2002, the DNB Household survey included 16 hypothetical inter-temporal choice questions which were developed by Tu (2004) based on experimental work by Thaler (1981) and Loewenstein (1988). The discounted utility (DU) model assumes that decision makers have a single discount rate across gains and losses, and for delaying and speeding-up a payment when comparing inter-temporal choices. However, Thaler (1981) and Loewenstein (1988) contest the assumption that individuals' self-determined discount rates vary according to different situations, since they demand a higher premium for delaying a sure payment than the cost to pay for speeding-up the same amount.

In particular, individuals have different discount rates for gains and losses, and qualitatively different attitudes towards borrowing and lending (Loewenstein and Prelec, 1992). This inter-temporal choice model incorporates the loss aversion effects of individuals in terms of framing their gains and losses relative to their subjective discount rates. Loewenstein (1988) specifies three terms to define individuals' preferences: the immediate consumption price, the delayed consumption price, and the speeding-up consumption price. The *delayed premium cost* is a compensation for

delayed consumption compared to the immediate consumption, and the *speeding-up cost* is a sacrifice to advance the delayed consumption to immediate consumption.

16 questions developed by Tu (2004) differ by four components: delaying (*D*) vs. speeding-up (*S*) a payment; gains (*G*) vs. losses (*L*); a time dimension (*T*) of 3 months vs. 1 year; and the size of the payment (*X*) which are *ƒ* 1000 vs. *ƒ* 100,000 in Dutch guilders. The gains arise from winning a prize in the National lottery, and the losses arise from a tax assessment. For example, the *Delay of Gain* question asks an individual to state the required additional amount to compensate for postponing the prize of *ƒ1,000* for one year. Questions on (1) '*Delay of a Gain'* and (2) *'Speed-up of a loss'* with an amount of *ƒ1,000* for a 1 year time dimension are presented as below.

(1) '*Imagine that you win a prize of ƒ1,000 (€454) in the National Lottery. The prize is to be paid out today. Imagine, however, that the lottery asks if you are prepared to wait A YEAR before you get the prize (there is no risk involved in this wait). How much extra money would you ask to receive AT LEAST to compensate for the waiting term of a year? If you agree on the waiting term without the need to receive extra money for that, please type 0 (zero) – AT LEAST a compensation of* ***ƒ____****.'*

(2) '*Imagine that you receive a tax assessment of ƒ1,000 (€454). The assessment has to be settled within A YEAR. It is, however, possible to settle the assessment now, and in that case you will get a REDUCTION. How much REDUCTION would you like to get AT LEAST for settling the assessment now instead of after a year? If you are not interested in getting a reduction for paying early or if you think there is no need to get a reduction for paying early, please type 0 (zero) – AT LEAST a reduction of* ***ƒ____****.'*

The *Delay of Gain* (DG) question (1) asks an individual to state the required additional amount to compensate for postponing the prize of *ƒ1,000* for one year. If the individual states *ƒ200,* this amount is to compensate for the waiting time of one year, and the final payment of *ƒ1,200* will be made. Similarly, the *Speed-up of a Loss* (SL) question (2) is framed to distinguish how much an individual expects to reduce their final payments through expediting the payment due in the future. If the individual states *ƒ200* as his demanded reduction, the tax assessment will be reduced to *ƒ800,* as an immediate payment.

From the answers to the 16 questions, we winsorise extreme values and undertake a validity check for two types of judgment errors following Dimmock and Kouwenberg (2010). First, we discard respondents who answer zero to all questions each year as we consider that they did not pay full attention to the questions[19]. Second, we winsorise individuals' responses at *X* (*ƒ*1,000 or *ƒ*100,000) for the *DG* questions and at 50% of *X* for the other questions to control for extreme values. We also compare the answers on the set of four questions for each situation to discard any responses displaying a judgment error.

For instance, on the *DG* situation, the four questions vary with *X* amount of either *ƒ*1000 or *ƒ*100,000 and a horizon *T* of either three months or one year. Thus if a respondent demands greater amounts for the premium to delay the gain for 3 months rather than delaying for one year for the same amount, or, if a respondent demands greater amounts as the premium for delaying *ƒ*1,000 rather than *ƒ*100,000 for the same horizon, we consider them as judgment errors and discard them.

[19] About 3-5% observations were deleted due to these individuals answering zero to all questions each year. Although it is possible that those individuals are not loss averse and hold a zero discount rate, it was impossible to determine whether their responses did indeed reflect this or whether, alternatively, were simply due to a lack of interest in participating in the survey. Following the approach of Dimmock and Kouwenberg (2010), therefore, we discarded them.

It has been emphasised by Thaler (1981), and Loewenstein and Prelec (1992), that dynamic inconsistency of time-preferences affects inter-temporal choices independently from loss aversion effects; thus we exclude questions with a three months horizon to avoid such discrepancies.

Table 3 Measuring Loss Aversion Coefficients and Discount Rates

Panel A - Intertemporal Choice Questions

Descriptive statistics for eight hypothetical inter-temporal decision questions of 400 individuals are presented below. These questions specify delaying vs. speeding-up a payment; gains vs. losses; payment size of *ƒ* 1000 vs. *ƒ* 100,000 in Dutch guilders with a time dimension of one year. The gains are from winning a prize in the National lottery situation and the losses are from a tax assessment. The *delayed premium cost* is a compensation for the delayed consumption compared to the immediate consumption, and the *speeding-up cost* is a sacrifice to advance the delayed consumption to immediate consumption.

Questions	Mean (%)	Median (%)	Std. Dev	Min	Max
% of Premium for Delay of Gain, *ƒ1,000*	17.82%	11.11%	17.012%	0%	100%
% of Premium for Delay of Gain, *ƒ100,000*	12.99%	7.94%	14.20%	0%	97%
% of Cost for Delay of Loss, *ƒ1,000*	3.06%	1.80%	4.418%	0%	27%
% of Cost for Delay of Loss, *ƒ100,000*	2.59%	1.74%	3.452%	0%	22%
% of Sacrifice to Speed up of Gain, *ƒ1,000*	4.02%	1.58%	7.803%	0%	50%
% of Sacrifice to Speed up of Gain, *ƒ100,000*	3.91%	1.76%	7.012%	0%	47%
% of Reduction by Speed up of Loss, *ƒ1,000*	9.59%	7.96%	7.394%	0%	47%
% of Reduction by Speed up of Loss, *ƒ100,000*	7.33%	5.40%	6.779%	0%	44%

Panel B - Estimation results of Loss-Aversion Coefficient and Discount Rate

Parameters	Mean	Median	Std. Dev.	Min	Max
Loss Aversion Coefficient	3.73	1.93	6.45	0.10	40
S.E. of Loss-Aversion	2.14	0.42	8.89	0.00	139.66
Discount Rate	7.7%	5.28%	7%	0.00%	100%
S.E. of Discount Rate	2.24%	1.36%	2.99%	0.00%	1.8%

Descriptive statistics of the responses for the eight questions with a time dimension of one year are presented in Panel A of Table 3. Individuals in our sample demand the highest premium for delay of gains as compared to all other situations. The mean value of 17.82% for the premium ratio indicates that individuals demand 178.2 guilders on average as their premium for delaying a gain of $f1000$ for a year. For the delay of losses, on the other hand, individuals only expect to pay $f30.6$ (3.06%) to delay a payment of $f1000$ for one year. They expect to spend less for their delay of losses and speed-up of gains, although they demand a high reduction from the speed-up of losses. These deviations violate the notions of conventional discounted utility (DU), which proposes the same discount rate for borrowing and lending circumstances.

We adopt the derived equations of the inter-temporal choice questions from Dimmock and Kouwenberg (2010) based on the reference point model of Loewenstein (1988). The value of a payoff at time 0, X_0 and at time T, X_T is expressed as below in Equation (3.1).

$$(3.1) \qquad V(X_0, X_T ; R) = v(X_0 - R) + \delta(T)\, v(X_T - R)$$

R assigns the reference point which is subject to $0 < R \leq X$. δ (T) refers to the individual's discount rate factor over the length of T, and v ($\cdot$) is the value function evaluating the payoff, in which $v(0) = 0$. In the situation of '*Delay of a Gain'* (DG), for example, an individual expects to receive an amount X at time 0. Conditional on the expected amount of compensation (P_{DG}), however, the individual is willing to delay the gain of X to time T. In this case, individuals are indifferent as to receiving either (X, 0) or (0, $X + P_{DG}$).

$$(3.2) \qquad V(X, 0; R) = V(0, X + P_{DG}; R)$$

(3.3) $v(X - R) + \delta(T)v(- R) = v(0 - R) + \delta(T)v(X + P_{DG} - R)$

Dimmock and Kouwenberg (2010) specify the value function v (·) based on prospect theory (Kahneman and Tversky, 1979), where the curvature parameter equals to one (Barberis and Huang, 2001; Barberis, Huang and Santos, 2001), and $\lambda > 1$ suggest the loss aversion as follow.

(3.4) $$V(X) = \begin{cases} x, \text{if } x \geq 0 \\ \lambda x, \text{if } x < 0 \end{cases}$$

Then, the Equation (3.3) can be rewritten.

(3.5) $X - R - \delta(T)\lambda R = -\lambda R + \delta(T)(X + P_{DG} - R)$

(3.6) $P_{DG} = [\ (1 - \delta(T))(X - R) + (1 - \delta(T))\lambda R\ ] / \delta(T)$

Loewenstein (1988) indicates that the reference point ranges from $0 < R \leq X$. To simplify the equation, however, we apply Loewenstein's (1988) full reference point adjustment which makes R equals X, i.e. $r = R / X = 1$. This full reference point approach provides the most effective results according to the findings of Dimmock and Kouwenberg (2010). The proportion of P_{DG} in relation to X is defined as p_{DG}. The delayed premium cost ratio p_{DG} can be expressed as a function of the loss aversion parameter and the discount rate.

(3.7) $p_{DG} = (1 - \delta(T))[\ (1 - r) + \lambda r\ ] / \delta(T) = \lambda\ (1 - \delta(T)) / \delta(T)$

The premium ratio should be positive and bounded, given $\lambda > 1$ and $0 < \delta(T) \leq 1$. Dimmock and Kouwenberg (2010) take the same steps to derive equations for the other three situations involving speeding-up of a gain (SG), delay of a loss (DL), and speeding-up of a loss (DL).

(3.8) $p_{SG} = (1 - \delta(T))$

(3.9) $p_{DL} = (1/\lambda)\ (1 - \delta(T)) / \delta(T)$

(3.10) $p_{SL} = (1 - \delta(T))$

As in derived equations, we estimate the loss aversion coefficient (λ_i), and discount rate (δ_i) of an individual based on the calculated ratios of each question ($p_{DG,i,t}$(X, T), $p_{SG,i,t}$(X, T), $p_{DL,i,t}$(X, T) and $p_{SL,i,t}$(X, T)). The ratio *p* has been defined as P/X. Two parameters are required to meet the conditions of $\lambda_i > 0$, and $0 < \delta_i \leq 1$. We denote that individual *i* expects the payment *P* for the delay or speed up of the amount X (1000 or 100,000 guilders) for time T (one year only), over the survey period t (1997–2002). As not all individuals have participated in the survey for six years, our panel is unbalanced; thus we include all available years with valid answers, and denote as Σ_t. For the delay of gain question, for instance, $n_{DG,i}$ denotes the number of years for which individual *i* participated. Adopting the GMM estimations with Loewenstein (1988)'s full reference point (r=R/X=1), Dimmock and Kouwenberg (2010) develop the following equations.

(3.11) $\sum_t p_{DG,i,t}(\mathrm{X, Y}) / n_{DG,i} - [\lambda_i(1-\delta_i^T)\ \delta_i^{-T}]$

$\sum_t p_{SG,i,t}(\mathrm{X, Y}) / n_{SG,i} - [(1-\delta_i^T)]$

$\sum_t p_{DL,i,t}(\mathrm{X, Y}) / n_{DL,i} - [(1/\lambda_i)(1-\delta_i^T)\ \delta_i^{-T}]$

$\sum_t p_{SL,i,t}(\mathrm{X, Y}) / n_{SL,i} - [(1-\delta_i^T)]$

The GMM estimations minimise the sum of the squared errors as in Equation (3.12) when deriving two parameters from the eight moments situation (Dimmock and Kouwenberg, 2010, pp.451).

(3.12) $\sum_X \sum_T [\, u_{DG,i\,(X,T)^2} + u_{SG,i\,(X,T)^2} + u_{DL,i\,(X,T)^2} + u_{SL,i\,(X,T)^2}\,]$.

From the calculated ratios from each question, we derive equations based on the full reference point adjustment model of Loewenstein (1988), which provides the most effective results according to the findings in Dimmock and Kouwenberg (2010). Through adopting the Generalized Methods of Moments (GMM) estimations to minimise the sum of the squared errors, we derive two parameters i.e. the loss aversion coefficient and discount rate, from the eight moments situation. Descriptive statistics of the two parameters are presented in Panel B of Table 3. The loss aversion coefficient and discount rate are estimated for each individual based on their average responses over 1997-2002. When the two parameters are calculated, the GMM estimations report standard errors for each parameter and for each individual. Thus, we also report descriptive statistics of standard errors from the estimations for the two parameters.

85% of our investors have loss aversion coefficients higher than 1, which means that they are loss averse (1 indicates that they are indifferent to a loss and gain of the same value). The mean (3.73) and median (1.93) values of the loss aversion coefficient indicate considerable skewness to the right. The mean estimated annual discount rate is 7.7%, and the median value is 5.28%. By comparison, the estimations of Dimmock and Kouwenberg (2010), based on the full reference point adjustment model of Loewenstein (1988), give mean and median values of the loss aversion coefficients which are higher (mean 5.61; median 2.47), and estimated discount rates which are lower (mean 5%; median 4%), than our estimations. Dimmock and Kouwenberg (2010) include all individuals in the panel rather than restricting their sample to investors only, which indicate that investors have lower loss aversion coefficients and higher discount rates than the population as a whole. Our estimations are in line with Dimmock and Kouwenberg (2010) who use the same dataset, as well as with Tversky and Kahneman (1992) who find that individuals hold the loss aversion coefficient of 2.25.

Table 4 Questions on Other Psychological Variables

Risk-aversion

Do you agree with the statement?

"I would never consider investments in shares because I find this too risky".

	Strongly disagree 1	**2**	**3**	**4**	**5**	**6**	**Strongly agree 7**	**Total**
N	57	65	43	47	19	19	15	400
(%)	(21.5%)	(24.5%)	(16.2%)	(17.7%)	(7.2%)	(7.2%)	(5.7%)	(100%)

Time Preference

Do you agree with the statement?

"I often work on things that will only pay off in a couple of years".

	Strongly disagree 1	**2**	**3**	**4**	**5**	**6**	**Strongly agree 7**	**Total**
N	17	41	53	51	69	25	9	400
(%)	(6.4%)	(15.5%)	(20%)	(19.2%)	(26%)	(9.4%)	(3.4%)	(100%)

Reference Point

When you evaluate the performance of your stock investments (including stocks in investment funds), what is your relevant benchmark?

Categories	**The price paid**	**Savings account**	**AEX index**	**Other**	**Total**
N	227	118	34	21	400
(%)	(56.8%)	(29.5%)	(8.5%)	(5.2%)	(100%)

Framing Patterns

When you evaluate the performance of your investments do you look at the performance of individual shares or the performance of the whole portfolio?

Categories	**Individual shares**	**Both**	**Whole portfolio**	**Total**
N	89	142	169	400
(%)	(22.3%)	(35.5%)	(42.3%)	(100%)

3.4.3 Risk Aversion and Time Preference

Previous studies, including Barsky *et al*. (1997) and Donkers and van Soest (1999), point out that stock market participation is significantly and negatively correlated with investors' level of risk-aversion; if investors are highly risk averse, they are unwilling to invest in risky assets. We select questions from the DHS, which enable us to determine individuals' subjective risk aversion level and time preferences as shown in Table 4. Veld-Merkoulova (2011) also uses these variables as proxies for individual investors' preferences in asset allocation.

Individuals are asked whether they agree with a statement *'I would never consider investments in shares, because I find this too risky'*. Respondents select an answer on a Likert scale from 1 (totally disagree) to 7 (totally agree). Based on the median value of 3, we allocate those individuals who score the question from 1 to 3 to *High* (59%) and from 4 to 7 to *Low* (41%) levels of risk aversion respectively.

Investors' time preferences indicate whether they are short-term or long-term oriented in planning for the future. Balduzzi and Lynch (1999) and Lynch and Balduzzi (2000) emphasise that investors who have long-term objectives are inclined to invest a greater proportion of their wealth in stocks than investors with short-term objectives. To measure investors' degree of time preferences, we select a question, which asks individuals whether they agree with a statement of *"I often work on things that will only pay off in a couple of years"*. Individuals choose an answer on the Likert scale from 1 (totally disagree) to 7 (totally agree). Based on the median value, we divide individuals who select answers from 1 to 3 into the short-term preference group (43%) and those individuals who select from 4 to 7 into the long-term preference group (57%).

3.4.4 Reference Points and Framing Patterns

In Table 4, we also present the results from the questions on individual investors' reference points and framing patterns, which are obtained from our survey conducted in 2003. These questions are discussed in the study of risk perceptions of individual investors by Veld and Veld-Merkoulova (2008). The reference point, to which an individual compares his investment returns, is the most important point at the valuation stage of the prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992). Based on their experimental results, Thaler *et al*. (1997) argue that the reference point strongly influences investors' perceptions. When the subjects only perceive positive returns from the market under conditions of high inflation, they increase their investments in risky assets without realising that they are suffering from money illusion (Shafir, Diamond, and Tversky, 1997).

We offer the respondents a choice of reference points: the initial price paid for a stock, the returns on the savings account, the market index, and others. In our results, 57% indicate that they check mainly whether their investments increase in value compared to the price that they paid for them; around 30% compare with the return on the savings account; 8.5% consider whether their investments outperform the market indices, such as the AEX in the Netherlands, and 5% refer to other benchmarks. The number of individuals who choose the market index is unexpectedly low, while the majority select the initial price paid as their reference point, supporting the arguments of Samuelson and Zeckhauser (1988) and of Shefrin and Statman (1985).

The fact that framing patterns determine how the investments are perceived and subsequently evaluated by investors influences their imminent decisions (Thaler, 1999b). Kahneman and Lovallo (1993) argue that whether investors apply wide or narrow framing patterns affects their risk taking decisions considerably. If investors

evaluate the performance of individual company stocks in isolation, as in narrow framing, they face greater volatility than they do if evaluating the entire portfolio performance. In addition, Thaler *et al*. (1997) suggest that if investors frame their decisions narrowly, they will evaluate the performance more often, resulting in more frequent trading and *vice versa*. Barberis and Huang (2001) argue that the prevalence of narrow framing can help explain empirically observed high individual stock return and volatility patterns. We investigate investors' framing patterns by asking them whether they evaluate their portfolio as a whole or look at the performance of individual company shares. We find that 22% apply narrow framing by looking at the performance of individual company shares, 36% evaluate both individual company shares and the whole portfolio, and 42% focus on the whole portfolio.

3.5 Empirical Results

3.5.1 The Effects of MLA on the Investment Level

We investigate the joint effects of myopia, loss aversion and control variables on the share of investors' total financial assets invested in risky financial assets (SRFA) over our sample period. We apply the following model equation (3.13), including only investors in our sample, with observations of non-zero risky investment holdings. We estimate Prais-Winston (1954) regression models with panel-corrected standard errors (PCSE), after a Woodridge (2002) test detects autocorrelations in the disturbances[20]. We control for heteroskedasticity and autocorrelation following the recommendations of Beck and Katz (1995).

[20] Based on simulation results, Drukker (2003) further suggests that the autocorrelation test of Wooldridge (2002) has robust properties with regard to its size and power when the sample size is reasonable.

$$SRFA_{i,t} = \alpha + x'_i\beta + y'_{i,t}\gamma + z'_t\delta + \varepsilon_{i,t} \quad (3.13)$$
$$N(0, \sigma^2)$$

The dependent variable $SRFA_{it}$ denotes the observed share of risky financial assets in the total financial assets (decimals) of individual *i* at time *t* (1997–2010). x'_i is the vector of investors' time-invariant characteristics, which include the levels of myopia, loss aversion, discount rates, risk aversion level, time-preference level, reference points, framing patterns, gender, marital status, education level, and employment status. $y'_{i,t}$ is the vector of time-varying characteristics which include age, financial assets, and debt ratio. z'_t is a vector of year dummies, which applies to all individuals. By including year dummies, we account for year specific effects such as macro-economic conditions. $\varepsilon_{i,t}$ is a normally distributed error term which is corrected for the presence of arbitrary heteroskedasticity and serial correlation. Variable definitions are presented in Appendix A.

We present four specifications of the empirical model (3.13) in Table 5. Regression (1) includes all explanatory and control variables. Regression (2) excludes self-reported risk aversion and level of time preference. Regression (3) excludes reference points and framing pattern variables. Finally, regression (4) is estimated without any survey-based controls (risk aversion, time preference, reference points and framing patterns). In our models, we investigate the effect of myopia and loss aversion independently, as well as their interactions. To evaluate the effect of myopia, we omit HEHR (high evaluation frequency with high rebalancing frequency) as a reference category.

Table 5 The Effect of MLA on the Investment Level

The following table presents the results of Prais-Winsten regression of panel-corrected standard error (PCSE) estimates accounting for both heteroskedasticity and serial correlation of the disturbances. The dependent variable is the share of total financial assets invested in risky financial assets (SRFA) by individuals (in decimals). In our unbalanced panel, the total number of observations of non-zero risky financial assets is 1986 from 340 investors. Corrected *z*–statistics are in parentheses and the significance levels are denoted by asterisks, *** 1%, ** 5%, and * 10% (p-values are two-tailed).

		(1)		(2)		(3)		(4)	
SRFA	–/+	**Coef.**	**Z**	**Coef.**	**Z**	**Coef.**	**Z**	**Coef.**	**Z**
Level of Myopia									
HELR	+	-0.040	(-1.41)	-0.044	(-1.59)	-0.050*	(-1.78)	-0.053**	(-1.93)
LEHR	+	0.015	(0.40)	0.012	(0.32)	0.008	(0.22)	0.005	(0.13)
LELR	+	-0.063**	(-2.26)	-0.072***	(-2.68)	-0.069***	(-2.55)	-0.080***	(-3.07)
Loss Aversion (LA)	–	-0.004*	(-1.73)	-0.004*	(-1.76)	-0.004*	(-1.92)	-0.004**	(-1.93)
Level of MLA									
HELR*LA	+	0.005	(1.60)	0.005	(1.58)	0.006*	(1.88)	0.005*	(1.80)
LEHR* LA	+	-0.002	(-0.25)	-0.001	(-0.09)	0.000	(-0.01)	0.001	(0.12)
LELR* LA	+	0.005*	(1.79)	0.005**	(1.93)	0.005**	(1.98)	0.006**	(2.10)
Discount Rate	–	-0.067	(-0.57)	-0.059	(-0.50)	-0.083	(-0.72)	-0.076	(-0.65)
Risk Aversion	–	-0.043**	(-2.22)			-0.042**	(-2.19)		
Time Preference	–	-0.019	(-1.06)			-0.017	(-0.99)		
Reference Points									
Initial Price	–	-0.062**	(-1.98)	-0.069**	(-2.23)				
Savings account	–	-0.058*	(-1.74)	-0.070**	(-2.13)				
Others	–	-0.054	(-1.03)	-0.061	(-1.18)				
Framing Patterns									
Individual Shares	–	-0.054**	(-2.39)	-0.049**	(-2.20)				
Shares and Portfolio	–	0.038**	(1.94)	0.038**	(1.97)				
Gender (Men)	+	-0.003	(-0.12)	0.006	(0.26)	0.000	(0.02)	0.008	(0.36)
Age	+	0.002**	(2.03)	0.002*	(1.75)	0.002**	(2.01)	0.002*	(1.75)
Marriage	–/+	-0.029	(-1.39)	-0.032	(-1.53)	-0.032	(-1.57)	-0.034	(-1.66)
Education	+	-0.027	(-1.49)	-0.026	(-1.45)	-0.033*	(-1.85)	-0.032*	(-1.80)
Occupation									
Self-employed	+	0.137***	(4.24)	0.142***	(4.45)	0.130***	(3.99)	0.134***	(4.14)
Retired	+	0.101***	(3.37)	0.100***	(3.38)	0.091***	(3.09)	0.091***	(3.07)
Others	–/+	0.025	(0.75)	0.019	(0.58)	0.034	(1.05)	0.029	(0.88)
Financial Assets	+	0.001	(0.17)	0.003	(0.40)	0.003	(0.42)	0.004	(0.61)
Debt ratio	–	0.013**	(2.07)	0.013**	(2.04)	0.013**	(2.03)	0.013**	(2.00)
Year Effect		Significant		Significant		Significant		Significant	
Constant		0.457***	(6.87)	0.456***	(6.89)	0.419***	(7.34)	0.410***	(7.22)
Wald Test		**Chi2(1)**	**Prob.**	**Chi2(1)**	**Prob.**	**Chi2(1)**	**Prob.**	**Chi2(1)**	**Prob.**
HEHR*LA=LEHR*LA		0.06	0.799	0.01	0.928	0.00	0.991	0.02	0.902
HELR*LA=LELR*LA		0.01	0.933	0.05	0.815	0.00	0.945	0.02	0.897
HEHR*LA=HELR*LA		2.56	0.109	2.49	0.115	3.55*	0.060	3.25*	0.071
LEHR*LA=LELR*LA		0.74	0.391	0.54	0.463	0.46	0.498	0.33	0.565
HEHR*LA=LELR*LA		3.21*	0.073	3.73*	0.053	3.92**	0.048	4.42**	0.036
Effect of the Crisis		18.41***	0.000	18.90***	0.000	19.63***	0.000	19.89***	0.000
Mean y1998-y2007		-0.059		-0.061		-0.059		-0.061	
Mean y2008-y2010		-0.131		-0.134		-0.134		-0.136	
AR(1) Rho			0.648		0.642		0.637		0.638
R-Squared			0.227		0.225		0.217		0.215

When we consider the effect of myopia alone, investors with a low level of rebalancing frequency (HELR and in particular LELR groups) invest significantly less than investors with a short horizon (HEHR category). We observe no effect from the varying level of evaluation frequency as there is no significant difference between the varying levels of evaluation frequency given the same level of rebalancing frequency (LEHR compared to HEHR and LELR versus HELR). What is particularly important for our tests is whether the coefficients for loss aversion differ across groups with higher and lower frequencies of evaluation and/or rebalancing.

For the HEHR group, higher loss aversion leads to significantly lower level of risky investments (coefficient of –0.004). Taking into account interaction terms, we find that the loss aversion coefficient is not statistically significant for all other investors' groups. This means that higher loss aversion decreases risky assets share, but only for the investors who both frequently evaluate and rebalance their portfolios. This finding confirms the existence of myopic loss aversion among individual investors.

On the other hand, neither frequent evaluation of investment results nor frequent rebalancing, taken separately appear to systematically increase the effect of loss aversion on investors' portfolio holdings. For example, the differences between loss aversion effects for HEHR versus LEHR and for HELR versus LELR groups are small and not statistically significant (as shown by Wald test statistics in Table 5). We conclude that, for actual investment decisions, it is the combination of rebalancing and evaluation frequency that causes the myopic loss aversion effect. Our results are consistent with the strong interaction effect between rebalancing and evaluation frequencies, found by Langer and Weber (2008) in a controlled experimental setting**.**

The risk aversion variable shows expected significantly negative signs, indicating that investors, who describe themselves as more risk-averse, invest less in

equities. This result is consistent with our assumptions. Considerable disparities are observed between investors' different reference points. As compared with those who choose market return as a reference point, investors who choose other reference points have significantly less SRFA. Investors who compare their performance to the returns on savings accounts have the lowest SRFA. Although individuals' reference points may change over time, depending on stock market performance, especially during a bear market period, the question on investors' reference points is only asked in 2003. Thus, we fail to capture the time-specific effects over our sample period. With regard to framing patterns, investors who evaluate the performance of individual company shares separately, compared to the omitted category of evaluating the whole portfolio, hold significantly less risky assets. Investors who evaluate the performance of both individual shares and the whole portfolio, however, invest significantly more.

With regard to the control variables, as in the case of those of Haliassos and Bertaut (1995), our sample does not indicate a significant gender effect. We observe a positive relationship between age and the SRFA; older investors hold higher proportions of risky financial assets in their portfolios.[21] It has also been pointed out by Van Rooij *et al.* (2011) and Hurd (1990) that this could be due to the different mortality rates of richer and poorer households, i.e. rich people tend to live longer. Our results, however, contrast with the life-cycle theory of Cocco *et al.* (2005); specifically, their argument that the level of optimal investment in risky assets decreases with investors' age. In particular, considering that most Dutch investors are entitled to generous state pension (AOW) benefits as well as mandatory supplementary occupational pension arrangements, they are perhaps less afraid of holding extra risks in their portfolios, thus they hold a higher proportion of risky financial assets.

[21] The following article reports that self-employed households and couples over 65 years old were the wealthiest groups in the Netherlands in 2009. More information is available at: http://www.cbs.nl/en-GB/menu/themas/inkomen-bestedingen/publicaties/artikelen/archief/2010/2010-3011-wm.htm

Barber and Odean (2000; 2001) find that single investors are less risk averse and invest more, while Agnew *et al*. (2003) argue that stock allocations should be higher for married investors, as having dual earners in a household also enables more diversification possibilities. In our sample, however, we do not observe any significant effect from the marital status of investors. We do not observe a significant education effect from our first two model specifications. In model specifications 3 and 4, however, we observe that those investors with a college or university degree invest a significantly smaller proportion of their financial portfolios in risky financial assets in contrast to our expectation, although only at the 10% significance level. These results indicate that individuals' education levels are different from their level of financial literacy (Van Rooij *et al*., 2011; 2012).

Self-employed and retired individuals invest at significantly higher levels than individuals in regular employment. Our finding is consistent with Barsky *et al*. (1997), who argue that self-employed people are more risk tolerant and thus invest more in risky assets[22]. Self-employed individuals in the Netherlands can arrange individual pension provisions supplementary to their state pension (AOW) benefits. Although they are eligible to annual special tax allowance deferring the tax payment over that amount, they will not be able to enjoy employer's contributions (Alessie *et al*. 2000). Also, their risky income stream makes it harder for them to save on a regular basis to their pension plans. Therefore, an alternative argument for higher stock-ownership by self-employed individuals is for their pension purpose on retirement to generate a 'pot of gold'.

The size of total financial assets is not significantly related to investments in risky assets. The effect of debt ratio is, however, positive and significant, showing

[22] Using US data, Heaton and Lucas (2000) argue that self-employed investors hold greater amounts of their own business equities, but comparably little common stock. We exclude any equity holdings in self-employed individuals' own businesses; thus, our finding cannot be explained by the argument of Heaton and Lucas (2000).

opposite signs from those we expected. This suggests that those investors who hold higher levels of total debt in relation to their total assets hold more risky financial assets in their financial portfolios, possibly reflecting greater risk tolerance. This finding is consistent with that of Heaton and Lucas (2000) who suggest that some stocks are indirectly financed by mortgage debts. Consequently, a higher mortgage is associated with higher stock holding. Correspondingly, Alessie *et al*. (2002) report that the abolition of the tax deductibility for mortgages on real estate and second-home investments in 2001 is due to the exploitation of low mortgage interest and tax deductibility benefits by Dutch individuals. In 1999, only 40% of new mortgages were issued to purchase first homes, the rest were issued to individuals to speculate on the increase in house prices, or to finance stock market operations.

We observe significant year effects, which reflect high fluctuations in investors' holdings of risky financial assets over time. Taking 1997 as a reference year, we also investigate the effect of the 2008 financial crisis as presented in Table 5. Through comparing the average values of pre- and post-crisis time dummy variable coefficients, we observe that investors' investment levels fell significantly after the crisis.

3.5.2 The Effect of MLA on the Investment Level Changes Over Time

To test our second hypothesis, we investigate the joint effects of myopia and loss aversion on the yearly changes of the SRFA of individuals. We consider the dynamic aspects of investment level changes especially important, as we can identify how MLA affects investment decisions over time within our panel dataset. To address such dynamic effects, we control for the lagged changes in individuals' SRFA. To this end, we develop a structural state dependence model including the lagged dependent variable in addition to those observed exogenous variables and unobserved disturbances.

The changes in investment level are also persistently influenced by unobserved explanatory variables in our model, consequently causing serial correlations if we fail to account for the initial conditions in this dynamic context. Thus we include the initial conditions in our model which are derived from individuals' SRFA levels at the beginning of the observation period as suggested by Wooldridge (2005). Including investors and non-investors in our sample, the dependent variable has a minimum value of -1 and a maximum value of 1, while most observations are concentrated around zero due to having a large number of individuals who are consistently holding zero risky financial assets over time in our sample.

$$\Delta SRFA_{\,i,t+1} = \alpha_1 \Delta SRFA_{i,t} + \alpha_2 \mathrm{SRFA}_{\,i,t} + \mathrm{x}'_i\beta + \Delta \mathrm{y}'_{i,t}\gamma + \mathrm{z}'_t\delta + \varepsilon_{i,t} \qquad (3.14)$$

$$N(0, \sigma^2)$$

As in Equation (3.13), we control for heteroskedasticity and autocorrelations in the disturbances by employing a Prais-Winston regression (1954) with panel-corrected standard error (PCSE) estimates. In equation (3.14), $\Delta SRFA_{\,i,t+1}$, the dependent variable, (in decimals) denotes the changes in share allocated to risky financial assets from total financial assets by individual *i* over time *t* (1997–2010). The lagged dependent variable, $\Delta SRFA_{i,t}$, and initial investment level $\mathrm{SRFA}_{\,i,t}$, are included as covariates as discussed above. As in our Equation (3.13), in Equation (3.14), x'_i is the vector of investors' time-invariant variables: the levels of myopia, loss aversion and discount rates, risk aversion level, time-preference level, reference points, framing patterns, gender, marital status, education level, and employment status. $\Delta \mathrm{y}'_{i,t}$ is the vector of the annual changes in time-varying characteristics of individuals; these are age, financial assets, and debts ratio. z'_t is a vector for the constant, and year dummies. $\varepsilon_{i,t}$ is a normally distributed error term which is robust to the presence of arbitrary heteroskedasticity and serial correlation.

Table 6 The Effect of MLA on the Changes in Investment Level

The following table presents the results of Prais-Winsten regression of panel-corrected standard error (PCSE) estimates accounting for both heteroskedasticity and serial correlation of the disturbances. Testing hypothesis H2, the dependent variable (in decimals) is the change in the share of total financial assets invested in risky financial assets (SRFA) by individuals. In our unbalanced panel, including the lagged dependent variable, the total number of observations including zero and non-zero risky financial assets is 2147 from 347 individuals. Corrected *z*–statistics are in parentheses and the significance levels are denoted by asterisks, *** 1%, ** 5%, and * 10% (p-values are two-tailed).

		(1)		(2)		(3)		(4)	
ΔSRFA	–/+	**Coef.**	**Z**	**Coef.**	**Z**	**Coef.**	**Z**	**Coef.**	**Z**
Lag ΔSRFA	–	-0.438***	(-20.61)	-0.435***	(-20.13)	-0.437***	(-20.36)	-0.435***	(-20.01)
SRFA	+	0.494***	(23.20)	0.471***	(22.42)	0.481***	(22.69)	0.462***	(21.95)
Level of Myopia									
HELR	+	0.008	(0.49)	0.025	(1.45)	0.014	(0.79)	0.030*	(1.77)
LEHR	+	0.018	(0.90)	0.027	(1.33)	0.023	(1.11)	0.032	(1.53)
LELR	+	0.033*	(1.92)	0.058***	(3.60)	0.041**	(2.44)	0.068***	(4.30)
Loss Aversion (LA)	–	-0.001	(-0.35)	0.000	(-0.31)	0.000	(-0.21)	0.000	(-0.20)
Level of MLA									
HELR* LA	+	-0.001	(-0.27)	0.000	(-0.14)	-0.001	(-0.50)	-0.001	(-0.32)
LEHR* LA	+	0.003	(1.37)	0.003	(1.39)	0.002	(1.10)	0.003	(1.18)
LELR* LA	+	0.000	(-0.21)	-0.001	(-0.41)	-0.001	(-0.33)	-0.001	(-0.51)
Discount Rate	–/+	0.144***	(2.54)	0.128**	(2.25)	0.155***	(2.74)	0.140**	(2.44)
Risk Aversion	–	0.065***	(5.88)			0.065***	(5.86)		
Time Preferences	–/+	-0.007	(-0.77)			-0.010	(-1.09)		
Reference Points									
Initial Price	–	0.013	(0.75)	0.021	(1.23)				
Savings	–	0.020	(1.11)	0.029	(1.61)				
Others	–	0.006	(0.26)	0.005	(0.21)				
Framing Patterns									
Individual Shares	–	0.009	(0.83)	0.004	(0.32)				
Shares and Portfolio	–	-0.043***	(-3.79)	-0.045***	(-3.91)				
Gender (Men)	+	-0.009	(-0.75)	-0.025**	(-2.19)	-0.011	(-0.94)	-0.025**	(-2.27)
Age	–	-0.002***	(-4.39)	-0.002***	(-3.65)	-0.002***	(-4.19)	-0.002***	(-3.54)
Marriage	+	0.032***	(2.85)	0.031***	(2.89)	0.031***	(2.86)	0.031***	(2.86)
Education	+	-0.008	(-0.75)	-0.006	(-0.64)	-0.002	(-0.19)	-0.002	(-0.18)
Occupation									
Self-employed	+	-0.045**	(-2.18)	-0.048**	(-2.35)	-0.041**	(-1.99)	-0.043**	(-2.08)
Retired	+	-0.017	(-1.04)	-0.015	(-0.91)	-0.011	(-0.70)	-0.010	(-0.59)
Others	–/+	0.006	(0.41)	0.008	(0.54)	0.006	(0.41)	0.008	(0.54)
Δ Financial Assets	+	0.017***	(2.64)	0.018***	(2.71)	0.018***	(2.80)	0.019***	(2.86)
Δ Debt ratio	–	-0.002	(-0.59)	-0.002	(-0.60)	-0.002	(-0.69)	-0.002	(-0.72)
Year Effect		Significant		Significant		Significant		Significant	
Constant		-0.061	(-1.62)	-0.064*	(-1.72)	-0.068**	(-2.05)	-0.066**	(-2.00)
Wald Test		**Chi2(1)**	**Prob.**	**Chi2(1)**	**Prob.**	**Chi2(1)**	**Prob.**	**Chi2(1)**	**Prob.**
HELR=LELR		3.17*	0.075	6.01**	0.014	3.98**	0.046	7.89***	0.005
LEHR=LELR		0.62	0.430	2.80*	0.094	0.98	0.322	3.85**	0.050
AR(1) Rho			0.326		0.319		0.3242		0.3226
R-Squared			0.463		0.449		0.456		0.445

We present four model specifications in Table 6. For all of the specifications, the lagged dependent variables are significantly and negatively correlated with the dependent variable while initial investment levels are significantly and positively related to it. The negative autocorrelation of the changes in SRFA reflects individual investors' responses to the volatile market changes during the sample period. Although investors are aware that the market returns exhibit the tendency of mean reversion, they may suffer from the 'gambler's fallacy' (Tversky and Kahneman, 1971). According to this notion, gamblers often bet on a fair chance, perceiving a random sequence as reflecting true probabilities. If the sequence consistently favours one direction, they expect the next will exhibit the opposite tendency, i.e. a random process will self-correct. Thus, investors make changes to their SRFA in the direction opposite to their previous changes. Positive coefficients from risk aversion also support the risk-seeking behaviour of investors in the domain of losses (Kahneman and Tversky, 1979).

With respect to the effect of myopia, investors with low evaluation frequencies increase their SRFA over time, as indicated by the difference in coefficients between HEHR and LELR, as well as between HELR and LELR (according to the significant Wald test statistics as shown in Table 6). These positive effects from the infrequent evaluation become stronger and more significant in our specifications 2 and 4, when we exclude the effects of risk aversion and time preference. We observe no significant effect from either loss aversion or the interaction between myopia and loss aversion. Thus, our results indicate that, regardless of their loss aversion level, investors who evaluate their portfolios less frequently increase their SRFA over time. However, it appears that most of the myopic loss aversion effect has already made its impact on the investment levels in our sample, and the further changes in the portfolio allocations are not influenced by MLA.

Discount rate coefficients show a positive relationship with the changes in SRFA in our specifications. From the risk-aversion variable, we observe positive and statistically significant effects, in contrast to our expectations, which specify that highly risk averse investors increase their SRFA over time. Although we observe that investors with a high level of risk aversion hold significantly less risky financial assets from our previous model, this model indicates that they increase their investment over time. This phenomenon supports Kahneman and Tversky (1979) who describe the risk-seeking behaviour of investors in the domain of losses. According to them, investors tend to take more risks to avoid losses than to realise gains. Berkelaar, Kouwenberg, and Post (2004) also argue that when investors are confronted with losses, they seek to maximize the probability that terminal wealth exceeds their aspiration level, which is to achieve their break-even points. This is evidence of the break-even effect, in which loss averse investors prefer a gamble over a sure gain when they are below break-even. As such, we could expect investors to increase their investments in risky assets after experiencing losses.

Time preference variables and reference points of individuals appear to have no influence on the changes in SRFA over time. From the different framing patterns, compared to the reference category of the broad framing, evaluating the whole portfolio, investors who examine at both the performance of individual shares as well as the whole portfolio reduce their SRFA over time, while there is no significant difference from individuals who examine at the performance of individual company shares only. These results partly support the argument that broad framing which reduces the portfolio return volatility induces investors to undertake risk-taking decisions (Kahneman and Lovallo, 1993).

With regard to the demographical characteristics, we observe that male investors reduce their SRFA over time more than female investors. We suspect that male investors are more impatient than female investors, thus becoming easily pessimistic towards the market. Barber and Odean (2000, 2001) also argue that men tend to overtrade due to their over-confidence, yet results for men are worse than those for women.

Investor age shows a negative relationship with the changes in SRFA. Although older investors in our sample hold a higher SRFA, this result suggests that they reduce their holdings over time, which supports the life-cycle theory of Cocco *et al*. (2005). Marital status also plays a significantly positive role in the changes in the SRFA, supporting the argument of Agnew *et al*. (2003). We observe no significant effect of the varying education levels. Comparing different occupations of individuals, a negative trend is demonstrated by self-employed individuals as compared to regular employees. On the basis of our model specifications, changes in SRFA are significantly affected by changes in investors' financial assets, but not by the changes in their debt ratios.

3.5.3 Redefining Investment Level Changes

As Bilias, Georgarakos and Haliassos (2010) note, widespread portfolio inertia means that more than half of the households do not trade the stocks in their portfolios for extended periods of time. In many cases, investors do not actively rebalance their portfolios, but rather follow a passive buy-and-hold strategy. However, as the values of their equity holdings change due to market fluctuations, these will mechanically affect their shares of risky assets in total assets. In order to avoid treating such changes as deliberate investment decisions, possibly driven by MLA or other factors, in this section we control for the impact of market returns on the changes in SRFA.

We test whether the effects of MLA would be significant when we isolate the absolute changes in SRFA made solely by investors, by excluding the changes made passively due to market returns over the years. Firstly, we obtain yearly market returns r_t from the AEX Total Return Index, and then calculate investors' 'expected' SRFA (SRFA*) at time *t* through adjusting their SRFA level at time *t*-1 by the market return of r_t. From the reported values of individuals' SRFA at time *t*, we subtract the estimated SRFA* value at time *t*, to obtain the changes made by investors, $D.SRFA_{i,t}$. If investors did not actively change their investment levels in risky financial assets at that time, $D.SRFA_{i,t}$ should be equal to zero, on average. We estimate the following regression equation (3.15) which is similar to regression equation (3.14) except for the redefined dependent variable**.** We report four specifications of the regression model in Table 7 where we observe similar results to those in Table 6.

$$D.SRFA_{i,t} = \alpha_1 D.SRFA_{i,t-1} + \alpha_2 \text{SRFA}_{i,t} + x'_i\beta + \Delta y'_{i,t}\gamma + z'_t\delta + \varepsilon_{i,t} \quad (3.15)$$

$$D.SRFA_{i,t} = \text{SRFA}_{i,t} - SRFA^*_{i,t}$$

$$SFA^*_{i,t} = \frac{\text{Risky Financial Assets } (1 + r_t)}{\text{Risky Financial Assets } (1 + r_t) + \text{ Other Financial Assets}}$$

$$r_t = \frac{\text{AEXI}_t - \text{AEXI}_{t-1}}{\text{AEXI}_{t-1}}$$

Coefficients for LEHR and LELR are all positive, and 6 out of 8 of them are statistically significant. This suggests that changes in the proportion of individual investors' financial portfolios invested in risky assets are positively related to the low level of evaluation frequency, supporting our findings. Thus, our robustness check confirms that regardless of the loss aversion level, infrequent evaluation positively affects investment level changes, supporting Bellemare *et al*. (2005). With regard to other control variables, most relationships are similar to those in Table 6. Thus, we can

confirm that redefining the dependent variable by controlling for the impact of market return on the changes of investors' SRFA over time does not influence our results on the relationship between myopia, loss aversion and changes in holdings of risky assets.

Table 7 The Effect of MLA on the Discretionary Changes in Investments

The following table presents the results of Prais-Winsten regression of panel-corrected standard error (PCSE) estimates accounting for both heteroskedasticity and serial correlation of the disturbances. Testing hypothesis H2, the dependent variable is the change in the share of total financial assets invested in risky financial assets (SRFA) by individuals, corrected for the market return over the period. In our unbalanced panel, including the lagged dependent variable, the total number of observations including zero and non-zero risky financial assets is 2147 from 347 individuals. Corrected *z*–statistics are in parentheses and the significance levels are denoted by asterisks, *** 1%, ** 5%, and * 10% (p-values are two-tailed).

		(1)		(2)		(3)		(4)	
D.SRFA	–/+	**Coef.**	**Z**	**Coef.**	**Z**	**Coef.**	**Z**	**Coef.**	**Z**
Lag D.SRFA	–	-0.431***	(-19.74)	-0.429***	(-19.41)	-0.431***	(-19.56)	-0.430***	(-19.29)
MRFA	+	0.450***	(21.84)	0.433***	(21.29)	0.440***	(21.40)	0.424***	(20.82)
Level of Myopia									
HELR	+	0.007	(0.44)	0.021	(1.30)	0.012	(0.70)	0.026	(1.57)
LEHR	+	0.023	(1.18)	0.030	(1.56)	0.026	(1.36)	0.034*	(1.74)
LELR	+	0.030*	(1.88)	0.052***	(3.41)	0.038**	(2.38)	0.061***	(4.07)
Loss Aversion (LA)	–	0.000	(-0.30)	0.000	(-0.26)	0.000	(-0.19)	0.000	(-0.18)
Level of MLA									
HELR* LA	+	-0.001	(-0.34)	0.000	(-0.23)	-0.001	(-0.53)	-0.001	(-0.36)
LEHR* LA	+	0.001	(0.60)	0.001	(0.63)	0.001	(0.38)	0.001	(0.46)
LELR* LA	+	0.000	(-0.24)	-0.001	(-0.42)	-0.001	(-0.34)	-0.001	(-0.51)
Discount Rate	–/+	0.123**	(2.24)	0.109**	(1.97)	0.133**	(2.42)	0.120**	(2.16)
Risk Aversion	–	0.056***	(5.28)			0.056***	(5.30)		
Time Preference	–/+	-0.006	(-0.64)			-0.008	(-0.92)		
Reference Points									
Initial Price	–	0.015	(0.91)	0.023	(1.34)				
Savings account	–	0.024	(1.35)	0.032*	(1.79)				
Others	–	0.009	(0.38)	0.008	(0.34)				
Framing Patterns									
Individual Shares	–	0.008	(0.72)	0.003	(0.27)				
Shares and Portfolio	–	-0.040***	(-3.68)	-0.041***	(-3.78)				
Gender (Men)	+	-0.010	(-0.86)	-0.023**	(-2.19)	-0.011	(-1.02)	-0.024	(-2.26)
Age	–	-0.002***	(-4.14)	-0.002***	(-3.46)	-0.002***	(-3.97)	-0.002***	(-3.37)
Marriage	+	0.029***	(2.72)	0.029***	(2.75)	0.029***	(2.74)	0.028***	(2.74)
Education	+	-0.008	(-0.89)	-0.008	(-0.80)	-0.003	(-0.34)	-0.003	(-0.34)
Occupation									
Self-employed	+	-0.040**	(-2.07)	-0.044**	(-2.24)	-0.037*	(-1.87)	-0.039**	(-1.96)
Retired	+	-0.016	(-1.08)	-0.015	(-0.97)	-0.011	(-0.74)	-0.010	(-0.65)
Others	–/+	0.007	(0.49)	0.009	(0.60)	0.007	(0.49)	0.009	(0.61)
Δ Financial Assets	+	0.019***	(2.91)	0.020***	(2.97)	0.020***	(3.06)	0.021***	(3.11)
Δ Debt ratio	–	0.000	(-0.02)	0.000	(-0.01)	0.000	(-0.14)	0.000	(-0.14)
Year Effect		Significant		Significant		Significant		Significant	
Constant		-0.096***	(-2.66)	-0.099***	(-2.75)	-0.099***	(-3.11)	-0.098***	(-3.06)
AR(1) Rho			0.283		0.280		0.284		0.284
R-Squared			0.433		0.423		0.428		0.419

3.6 Summary and Conclusions

We investigate the effects of Myopic Loss Aversion of Benartzi and Thaler (1995) on individual investors' portfolio allocation decisions. While myopic loss aversion has been studied previously in a laboratory setting, our study is the first to establish the effects of myopic loss aversion on actual investment behaviour. We use estimates of investors' myopia and loss aversion, combined with detailed panel data from the Dutch Household Survey. Following Langer and Weber (2008), we disentangle evaluation frequency from rebalancing frequency. The effect of myopia is combined with individuals' varying levels of loss aversion, which we estimate from their responses to the hypothetical intertemporal choice questions developed by Thaler (1981) and Loewenstein (1988).

We observe that the combination of short investment horizons with loss aversion has significant negative effects on individuals' investments in risky financial assets. This result confirms that the myopic loss aversion theory of Benartzi and Thaler (1995) holds for actual investment decisions. Our results also show that both evaluation frequency and rebalancing frequency play significant roles. Among highly loss averse individuals, only those who both evaluate and rebalance their portfolios frequently allocate a lower share to risky financial assets. This result supports the experimental findings of Langer and Weber (2008) on the interaction between portfolio evaluation and rebalancing. When we further investigate changes in investors' investments in risky financial assets over time, infrequent evaluation influences them positively to increase their holdings, but loss aversion has no effect. This result is robust to controlling for the impact of market returns on individuals' levels of risky assets.

Overall, we find that the widespread existence of myopic loss aversion affects the financial decision-making of individuals. High loss aversion, combined with the

propensity to frequently evaluate investment performance and to change the composition of investment portfolios, leads to lower investments in risky assets and to utility losses over investors' lifetimes. However, once individuals establish their risky asset allocations according to their levels of both loss aversion and myopia, myopic loss aversion is unlikely to further decrease their levels of risky investments. These results support the suggestion that long-term investment vehicles (such as defined contribution pension funds) should offer default asset allocations with higher proportions of risky assets in order to provide more gains from equity market participation across broader ranges of investors.

Chapter 4 Stock Market Expectations and Risk Aversion of Individual Investors

Abstract

We investigate the relationship between individuals' stock market return expectations and risk aversion, and test whether the joint effects arising from the interaction of these two variables affect individuals' investment decisions. Both individuals' stock market expectations and risk aversion levels are elicited from the Dutch National Bank Household Survey (DHS) over the period 2004-2006. From our findings, we observe that individuals' risk aversion levels have significant and negative effects on their stock market expectations. With regard to individuals' stock market participation decisions, we identify significant and negative effects arising from the interaction between stock market expectations and risk aversion in addition to the significant and positive effect from stock market return expectations, and the significant and negative effect from risk aversion, singularly. Once individuals participate in the stock market, however, their stock market expectations alone remain significant in determining their portfolio allocation decisions.

4.1 Introduction

There is a growing consensus (Hurd, Van Rooij, and Winter, 2011; Kezdi and Willis, 2009; Dominitz and Manski, 2007) that the heterogeneous stock market expectations of individuals may provide an answer to the puzzling question as to why so few individuals hold stocks (Haliassos and Bertaut, 1995). Based on the argument of Haliassos and Bertaut (1995), however, heterogeneity in belief does not appear to explain the stockholding puzzle. They state in their paper that, *heterogeneity of opinions is not promising, since what is required is the perception that a premium exists, not that it is of a particular magnitude (pp.1114).*

The motivation of Chapter Four derives from the difference in understanding between the current literature which argues that heterogeneous stock market expectations alone explain the stockholding puzzle adequately, and the concern raised by Haliassos and Bertaut (1995) to the effect that it is crucial to identify whether investors hold the *perception that a premium exists*. Manski (2004) also argues that in order to understand individuals' expectations properly, it is necessary to thoroughly investigate individuals' perceptions of the environment and processing of new information.

As previously argued by Barsky, Juster, Kimball, and Shapiro (1997), Donkers and van Soest (1999) and Kapteyn and Teppa (2011), there are systematic variations in individuals' risk aversion levels which determine their risk taking decisions. Individuals may face the same risk-free rate in the market, while perceiving the uncertainty over equity returns differently from each other since they implicitly employ both different risk measures and different benchmarks (Veld and Veld-Merkoulova, 2008). Most studies, including Hurd, Van Rooij, and Winter (2011) and Dominitz and Manski, 2007, however, do not emphasise the effect of risk aversion on either stock market

expectations or stock holding decisions. In particular, Hurd, Van Rooij, and Winter (2011) argue that individuals' stock market expectations alone can explain the stock holding puzzle adequately without any need to invoke individuals' risk aversion levels.

According to Rabin and Thaler (2001, p.210), risk aversion is "*hesitation over risky monetary prospects even when they involve an expected gain"*, thus lending support to arguments that individuals' risk aversion levels affect individuals' stock market return expectations negatively and also their stock investment decisions. As such, it is crucial to identify whether the effect of stock market expectations on individuals' portfolio allocation decisions is the same for those with varying levels of risk aversion.

In this study, we account for the negative effect of risk aversion on the stock market return expectations of individual investors. Further, we investigate the interactions between stock market expectations and risk aversion levels on individuals' portfolio allocation decisions. In order to disentangle the effect of risk aversion from that of individuals' stock market expectations, we first consider whether individuals' stock market expectations depend on their levels of risk aversion. Second, we study whether individuals' stock market expectations and their risk aversion levels jointly determine their stock market participation decisions. Thirdly, we test whether for stock market investors, their expectations and their levels of risk aversion jointly determine their portfolio allocation decisions, i.e. the proportion of risky financial assets held in their financial portfolios.

We obtain both individuals' stock market expectations and risk aversion levels from the Dutch National Bank Household Survey (DHS) over the period 2004-2006. We measure individuals' stock market expectations by a question which elicits individuals' expectations as to stock price changes one year ahead on the basis of point

forecasts in a similar fashion to Vissing-Jørgensen (2003). Our risk aversion measure is obtained from a series of questions evaluating individuals' risk preferences in terms of investment strategy[23]. We use the approach suggested by Kapteyn and Teppa (2011) to elicit individuals' risk aversion levels by applying factor analysis to survey responses. Our analysis is based on detailed information on individuals' financial, demographical, and behavioural characteristics which is available from the covariate-rich DHS.

In accounting for the effect of individuals' stock market expectations on their stock market participation decisions, the expectations variable gives rise to a clear endogeneity issue given that individuals' expectations are also affected by their stock ownership status. Thus in order to account for the causality issue, we apply instrumental variables (IV) estimations with additional variables which act as instruments. We consider two instruments, namely individuals' expectations as to, first, their own financial situations, and, second, their investment horizons. These instruments are orthogonal within our models and significantly influence individuals' stock market expectations.

Consistent with our first hypothesis, we observe that individuals' risk aversion levels affect their stock market expectations, significantly and negatively. We also find in respect of our second hypothesis, that there are significant and negative interactions between stock market expectations and risk aversion levels on stock market participation decisions, in addition to their significant singularly effects. Regarding our third hypothesis, only stock market expectations exhibit significant and positive effects on portfolio allocation decisions, while the effect of risk aversion and of the interactions between stock market expectations and risk aversions are insignificant.

[23] To compute the risk aversion measure in Chapter 3, only one of the questions that with the most explanatory power, available from the DHS is used. In this chapter, we extend our approach in measuring risk aversion by including all six available questions from the DHS through applying a Principal Component Factor Analysis (PCA) in order to identify one factor variable as suggested by Kapteyn and Teppa (2011).

These findings confirm that once individuals participate in the stock market, risk aversion becomes irrelevant; thus we observe no significant interactions between stock market expectations and risk aversion. Nevertheless, individuals' stock market participation decisions are significantly influenced by both their expectations and their levels of risk aversion.

Our study contributes to the literature by addressing the effect of risk aversion in linking individuals' stock market expectations to their stock market participation decisions. Additionally, we consider the problem of endogeneity more rigorously than prior work does. In the remainder of this chapter, we present a literature review and our research hypotheses in section 2; we discuss our data and constructions of variables in section 3; we develop our empirical models and present the results in section 4; section 5 discusses our robustness checks; and finally, we summarise and discuss our findings in section 6.

4.2 Literature Review and Research Hypotheses

In response to the puzzling question as to why so few investors hold stocks in their portfolios (Haliassos and Bertaut, 1995), there is a growing consensus that the heterogeneous expectations of investors provide a possible answer to the stock market participation puzzle (Hurd *et al*. 2011; Kézdi and Willis, 2009; Dominitz and Manski, 2007). Despite the homogeneous expectation assumption of the Capital Asset Pricing Model (Sharpe, 1964; Lintner, 1965) whereby investors apply the same theoretical economic model to form the same expectation of market return and risk, these studies support the notion that investors' expectations are heterogeneous. According to Hong and Stein (2007), disagreements arise among investors, despite simultaneously available public information, because they use different economic models which cause

their interpretations of information to diverge from each other (Harris and Raviv, 1993; Kandel and Pearson, 1995). Similarly, Hurd (2009) posits that heterogeneous beliefs are more likely to be caused by deviations in the manner by which investors access and process publicly available information, rather than by private signals or scarcity of information.

Dominitz and Manski (2011) argue that individuals apply '*interpersonally variable'* but *'intrapersonally stable'* processes when they form their expectations, suggesting that the variations can be explained by the different ways in which individuals process public information. They categorise individuals by their expectations type (random walk, persistence, and mean-reversion) and conclude that although the central tendency of expectations takes the form of persistence, individuals' expected equity returns are heterogeneous. Their findings are consistent with those of Ito (1990) who argues that even under the extreme violation of the rational expectation hypothesis, which is grounded in a Bayesian approach, individuals exhibit widely heterogeneous expectations, thus confirming significant 'individual effects'.

Since individuals' expectations determine their consequent actions (Manski, 2004), understanding the effects of heterogeneous stock market expectations is recognised as crucial in explaining their portfolio allocation decisions. Vissing-Jørgensen (2003) finds that the heterogeneous beliefs of American investors are correlated with their investment choices, with those who expect higher stock returns holding higher proportions of equity in their portfolios. Dominitz and Manski (2007) also argue that heterogeneity in expected returns is reflected in individuals' stock holdings, with the probability of holding stocks increasing as US households' perceived likelihood of positive equity returns increases. Both Vissing-Jørgensen (2003) and Dominitz and Manski (2007) find that substantial heterogeneity in beliefs reflects demographical and

financial characteristics. Hurd *et al*. (2011) find, consistent with previous US-based studies such as Dominitz and Manski (2007), that substantial heterogeneity in the stock market expectations of Dutch households is a significant influence on their stock ownership. They argue that those households with expectations of higher future returns are more likely to own stocks, and those with expectations as to higher volatility in returns are less likely to do so. Based on a larger set of covariates, Hurd *et al.* (2011), in similar manner to Hudomiet *et al.* (2011) and Kézdi and Willis (2009), also consider the influences of socio-demographic information, personal traits (including factors such as optimism, trust, and risk aversion) and investment behaviour (including factors such as whether investors have recently traded or follow the stock market closely) on investors' expectations.

In response to Haliassos and Bertaut (1995), Dominitz and Manski (2007) find that many investors are not as convinced as are economists about the existence of an equity premium as they observe nearly two-thirds of US households believe that the probability of positive nominal equity returns is less than fifty per cent. Assuming that all individuals face the same risk-free rate and perceive the same level of uncertainty as to equity returns, Dominitz and Manski (2007) argue that the subjective probability of perceived positive nominal returns on equity determines the probability of equity holding. According to Veld and Veld-Merkoulova (2008), however, individuals perceive the level of uncertainty over equity returns differently from each other as they implicitly employ both different risk measures and different benchmarks. Their findings are consistent with the 'disagreements models' of Hong and Stein (2007). In particular, Barsky *et al.* (1997), Donkers and van Soest (1999) and Kapteyn and Teppa (2011) argue that different types of individuals are characterised by varying levels of risk aversion, symptomatic of their background and wealth characteristics.

Subsequently, Hurd *et al.* (2011) address individuals' risk aversion as an influential factor on stock market expectations. They find, however, that risk aversion has only a limited effect on both individuals' expected stock market returns and volatility and on their stockholding decisions. Thus they conclude that individuals' stock market expectations alone explain the stock holding puzzle adequately, without a need to invoke very high levels of risk aversion. The study of Kézdi and Willis (2009) is the only one which considers risk aversion as a link between individuals' subjective beliefs and their stockholdings. The estimated constant relative risk aversion (CRRA) parameters of individuals in their study are, however, much smaller than those identified by Mehra and Prescott (1985) using historical stock market returns. Thus they conclude that the effect of risk aversion as a link between individuals' beliefs and their stockholding is only moderate. These findings on heterogeneity in stock market expectations as well as on risk preferences are important, as both factors play a significant role in determining investment decisions.

After comparing different risk aversion measures, Kapteyn and Teppa (2011) argue that results are sensitive to the specific measures used; in particular the measures suggested by Barsky *et al*. (1997) have little explanatory power. Both Kézdi and Willis (2009) and Hurd *et al.* (2011) estimate individuals' risk aversion on the basis of survey responses to hypothetical gambles over lifetime income, developed by Barsky *et al*. (1997). Thus, the findings of Kézdi and Willis (2009) and Hurd *et al.* (2011), require careful interpretation and further validation by the application of a more powerful risk aversion measure.

Adopting different measures for both stock market returns expectations and the risk aversion of individuals from those used by Kézdi and Willis (2009), and Hurd *et al.* (2011), we disentangle the effect of risk aversion from that of individuals' expectations.

Firstly, we hypothesise that more risk averse individuals hold lower stock market returns expectations.

Hypothesis 1) More risk averse individuals hold lower stock market return expectations.

Secondly, we hypothesise that the interactions between stock market return expectations and individuals' risk aversion levels result in negative effects on their stock market participation decisions.

Hypothesis 2) The stock market return expectations of more risk averse individuals have a negative effect on their stock market participation decisions.

Thirdly, we hypothesise that the interactions between investors' levels of risk aversion and stock market return expectations have negative effects on their portfolio allocation decisions, i.e. the proportion of their financial portfolios allocated to risky financial assets.

Hypothesis 3) The stock market return expectations of more risk averse investors have a negative effect on their portfolio allocation decisions.

4.3 Data Description and Construction of the Variables

4.3.1 Data and Sample Selection

This study uses the Dutch National Bank Household Survey (DHS) which is an online survey conducted by the CentERdata panel in the Netherlands. Since 1993, this survey has been completed annually by approximately 3,000 panel members over 16 years old from about 2,000 households. With regard to the demographic characteristics of panel members, it is believed that the average panel member has experience and knowledge similar to that of the average person living in the Netherlands. Of the finance studies using this panel, Dong, Robinson, and Veld (2005) study the

preferences of individual investors on dividend payments; Veld and Veld-Merkoulova (2008) investigate individuals' risk perceptions and measurements; Veld-Merkoulova (2011) evaluates the relationship between investment horizon, labour income, and the portfolio choice of individual investors; and Van Rooij, Lusardi, and Alessie (2011, 2012) discuss the effect of financial literacy on stock market participation, retirement planning and household wealth. Recently, using the LISS panel[24], Kaplanski, Levy, Veld, and Veld-Merkoulova (2012) study the effects of sentiment-creating factors on individuals' perceived risk and stock market returns.

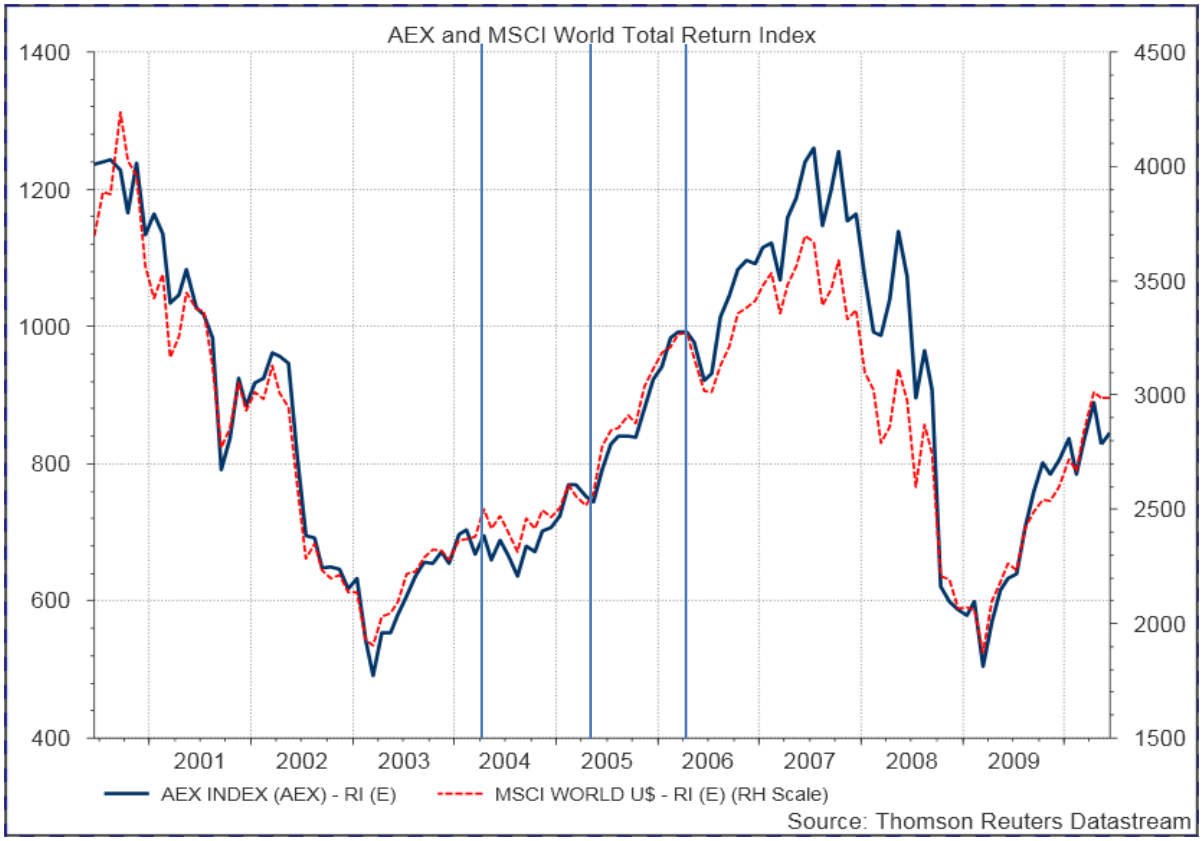
We obtain the data on individuals' stock market return expectations, which were the subject of a supplementary question asked by the DHS the period from 2004 to 2006, from the *Economic and Psychological Concepts* section. This period includes a market rebound and modest recovery, with revival starting in 2003, after three years of declining stock market prices worldwide following the dot-com crisis of 2001. On average, the DHS takes 7 to 8 months to obtain data covering the entire survey.

Questions are only asked during the weekend and most respondents answer during the first weekend that the questions are available. The stock market return question was released around late spring, and the majority of members answered on the 16th, 19th and 16th weekend of the years 2004, 2005 and 2006, respectively. We specify the response dates for the majority of individuals each year by drawing vertical lines in the graph in Figure 3, which shows the movements of the AEX and MSCI World total return indices from 2001 to 2009 (covering three years before and after our survey period) as a point of reference. There is a high correlation (0.9783; significant at 1% level) between these indices.

[24] Longitudinal Internet Studies for the Social Sciences (LISS) survey panel from the CentERdata; more information is available at: http://www.lissdata.nl/lissdata/

Figure 3 Historical Performance of the Market Indices[25]

The Figure below presents the historical performances of the AEX and MSCI World Total Return Index (RI) from 2001 to 2009, which spans three years before and after our survey period. The vertical lines indicate the timing of the repose from the individuals to the stock market expectation question each year.



[25] According to the Statistical Bulletin (June 2006, pp.21-25) reported by the Dutch National Bank, Dutch private investors, on average, hold only about 35% of their portfolios in foreign securities, indicating that the reminder is invested in the Netherlands. Thus, we include the MSCI World market index in addition to the AEX Dutch market index as reference levels.

Table 8 Sample Selection Process and Data Overview

Panel A - Sample Selection Process

The table below presents a sample selection process in our dataset for each year. We merge the stock price expectations survey question with general information of the household, assets and liabilities, and economic and psychological concepts datasets from the Dutch National Bank Household Survey (DHS).

Sample Selection Process (Total number of Observations)	**2004**	**2005**	**2006**	**Total**
Number of individuals' contacted	2015	2056	1779	5850
Participants in Stock Market Expectations Question	1547	1522	1248	4317
	(77%)	(74%)	(70%)	(74%)
"*I don't know*" responses	204	163	175	542
	(13%)	(11%)	(14%)	(13%)
Stock Market Expectations Question	1343	1359	1073	3775
Sample selecting process from merging with				
General Information on the Household Questions	1343	1359	1073	3775
Assets and Liabilities Questions	1186	1136	944	3266
Economic and Psychological Concepts Questions	1062	1029	865	2956
Total number of Observations	**1062**	**1029**	**865**	**2956**

Panel B - Background Characteristics

We present background characteristics of our sample measured for each year, including gender, marital status, age group, education level, employment status, house ownership status. The quartile values of individuals' total financial assets and net worth are presented in Euros. We also present the percentage of investors in the sample and the share of risky assets in financial portfolios held by investors.

Variables		**2004**	**2005**	**2006**	**Total**
Gender	Female	0.363	0.374	0.331	0.360
Marital Status	Married	0.769	75.5	0.768	0.764
Age Groups	35 and less	0.184	0.197	0.160	0.181
	From 36 to 50	0.320	0.290	0.252	0.279
	From 51 to 65	0.319	0.346	0.390	0.349
	65 and over	0.177	0.196	0.199	0.190
Education	College degree	0.497	0.477	0.476	0.484
Employment	Regular	0.562	0.538	0.513	0.540
	Self-employed	0.043	0.041	0.047	0.044
	Retired	0.199	0.216	0.245	0.218
	Unemployed	0.123	0.129	0.117	0.123
	Others	0.073	0.076	0.077	0.075
House Owner	Owner	0.754	0.740	0.751	0.748
Financial Asset	25%	€ 4,643	€ 4,089	€ 3,989	€ 4,285
(Percentile)	50%	€ 16,533	€ 17,280	€ 16,500	€ 16,662
	75%	€ 41,325	€ 47,185	€ 52,859	€ 45,954
Net Worth	25%	€ 12,312	€ 12,866	€ 13,038	€ 12,809
(Percentile)	50%	€ 68,163	€ 85,119	€ 96,504	€ 82,423
	75%	€ 216,922	€ 240,640	€ 261,755	€ 237,189
Market Participation	Investors	0.339	0.344	0.347	0.343
% of Risky Financial	25%	13.36%	10.52%	13.06%	12.23%
Held by Investors	50%	33.84%	29.17%	36.67%	32.89%
(Percentile)	75%	56.92%	59.06%	63.83%	60.97%

Our sample selection process is presented in Panel A of Table 8. The participation rate is around 74% which includes 13% '*I don't know*' responses. We exclude missing values as well as '*I don't know*' responses. Our panel dataset is then constructed by merging the expectation question with the datasets of the *General Information on the Household* section to obtain respondents' demographical backgrounds; the *Aggregate dataset of Asset and Liabilities* which provides the information about respondents' asset allocations, (we exclude missing values and those with zero financial assets); and the *Economic and Psychological Concepts* section which includes questions allowing us to measure risk aversion and other behavioural factors. We obtain a total of 2956 observations from 1587 individuals over 3 years.

As presented in Panel B of Table 8, the sample composition is similar over all years. Over our entire sample, we have about 36% of female respondents, and 64% of male respondents; about 76% are married or living with a partner; about 18% are less than 35 years old, 28% are between 36 and 50, 35% are between 51 and 65, and 19% are over 65, and about 50% have received a vocational college or university education. About half are in regular employment; about 5% are self-employed; about 20% are retired; about 10% are unemployed and less than 10% have other employment statuses; and about 75% own their house.

The DHS specifies detailed information concerning the assets, liabilities and mortgages of members. The aggregated data set includes a total of twenty-four main asset components, eight debt components and three mortgage components[26]. From the list of financial assets, we define risky financial assets as the sum of individual company shares, mutual funds[27], options and business equities. We treat other financial

[26] Values are determined by the market value on the last day of the previous year, e.g. in 2004, values are recorded as at 31 December 2003.

[27] The DHS does not specify subcomponents of the mutual fund category. Thus, if investors hold balanced funds, this category will include some element of fixed income ownership. According to

assets as non-risky, comprising savings and checking accounts, bonds, single-premium annuity insurance policies, employer sponsored savings plans, money lent to friends and family, and other savings or investments.[28] We report quartile values of individuals' financial assets and net worth[29] in Euros. Over our entire sample, there are about 34% of investors who hold about 33% (median) of risky financial assets within their financial asset portfolios.

4.3.2 Measuring Subjective Stock Market Expectations

Individuals' stock market expectations are estimated by their point forecasts in similar fashion to Vissing-Jørgensen (2003). The wording of the stock market expectation question which we consider in this study is as follows:

"How do you expect worldwide stock prices to move over the next two years - will stock prices increase, decrease or remain about the same? How many percentage points do you expect them to increase or decrease by per year?"

The question combines two parts to elicit individuals' expectations as to, firstly, the direction of future stock price movements, and secondly, changes in the magnitude of future returns. For our study, we only use expected changes in magnitude. Although Hurd *et al.* (2011) use the same panel to conduct their study, our question differs from those used by them. In their study, individuals are asked to imagine a hypothetical situation in which they unexpectedly received 10,000 Euros from a rich relative, and

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Alessie, Hochguertel, and van Soest (2004), about 50% of the total amount in mutual funds was invested in the stock market; about 30% in real estate; and about 10% in bonds in the Netherlands.

[28] Although we do not have information on individuals' retirement account, Dimmock and Kouwenberg (2010) note that in the Netherlands, the system of employer-sponsored pensions covers most employees, as it is controlled by the state and over 95% of these pensions are defined-benefit plans. Although we are aware that tax deferred equity investment in retirement accounts could influence individuals' private investment decisions, we do not account for the effects in this study. This is acknowledged as a limitation.

[29] Net worth is calculated by deducting total debts from total assets. Total assets comprise financial and fixed assets including real estate, and owners' houses, and cash value of insurance on real estate and owners' houses. Debts include private loans, extended lines of credit, debt with mail-order firms, loans from family and friends, student loans, credit card debt, and other debts, as well as mortgages on real estate and owners' houses.

are considering investing this amount in a mutual fund investing principally in blue chip stocks. Hurd *et al.* (2011) elicit individuals' beliefs as to the probability of eight possible outcomes, namely, gains and losses of more than 0%, 10%, 20%, and 30%, respectively, over a one year horizon.

The questions give rise to some concerns as to their validity, since according to Fitzsimons and Shiv (2001), hypothetical questions influence respondents' underlying psychological processes, consequently affecting their responses. The value of the hypothetical inheritance of 10,000 Euros to respondents may vary depending on their current wealth levels. The hypothetical inheritance may also create an endowment effect, distorting individuals' views (Kahneman, Knetsch, and Thaler, 1990).

Compared to that of Hurd *et al.* (2011), the question we use is simple and straightforward, eliciting individuals' intuitive expectations as to stock market returns worldwide. It is free from any potential bias arising from the incorporation of hypothetical circumstances. It may appear to compel respondents to provide point forecasts for their expectations without allowing them to express their uncertainty about the future (Manski, 2004). Nevertheless, Hurd *et al.* (2011) emphasise that most individuals in the CentERdata panel are experienced survey respondents and are likely, therefore, to provide meaningful answers.

Table 9 presents descriptive statistics of the survey results from the individuals' subjective stock market expectations question. To control for extreme outliers, we undertake a 99% winsorisation of each year's responses. In 2004, individuals indicate that stock prices will increase over the next two years by 3.82% per year on average (median: 2%); the average expected rate decreases to 2.25% in 2005 (median: 0%); and in 2006, individuals believe the market will increase on average by 3.94% per year (median: 3%).

Table 9 Stock Market Return Expectations Question and Results

The following table presents the results of individuals' expectations for the stock market returns over 2004-2006 in our sample. We report separate results for investors and non-investors in our sample. T values for the mean differences and Z scores from Wilcoxon rank-sum (Mann-Whitney) test for the median differences between investors and non-investors responses are reported from the estimations. The significance level is defined by the p-values of 1%***, 5%**, and 10%* (p-values are two-tailed).

Stock Market Expectations (%): "How do you expect stock prices to do over the next two years? By how many percentage points do you expect them to increase or decrease per year?"

	All Individuals						*Investors*						*Non-Investors*						*Mean*	*Median*
%	*Mean*	*Median*	*S.D*	*Min*	*Max*	*N*	*Mean*	*Median*	*S.D*	*Min*	*Max*	*N*	*Mean*	*Median*	*S.D*	*Min*	*Max*	*N*	*T-Stat*	*Z-Score*
2004	3.82%	2%	7.61%	-25%	40%	1062	6.00%	5%	7.88%	-25%	40%	359	2.71%	0%	7.21%	-25%	40%	703	6.62***	8.33***
2005	2.35%	0%	6.22%	-25%	30%	1029	3.64%	2%	5.91%	-30%	30%	354	1.67%	0%	6.27%	-25%	30%	675	4.96***	6.05***
2006	3.94%	3%	6.09%	-20%	30%	865	5.51%	5%	5.40%	-10%	30%	300	3.10%	2%	6.28%	-20%	30%	565	5.89***	7.07***
Total	3.34%	2%	6.76%	-25%	40%	2956	5.03%	5%	6.62%	-25%	40%	1013	2.46%	0%	6.65%	-25%	40%	1942	9.98***	12.22***

Table 10 Risk Aversion Measure and Principal Component Factor Analysis

The table below presents descriptive statistics from the responses, and factor analysis results. From our entire 2956 observations over three years, we create a factor based on principal component factor analysis (PCA). Individuals indicate on a scale from 1 to 7 to what extent they agree with the following statements, where 1 indicates 'totally disagree' and 7 indicates 'totally agree'. [R] indicates that individuals' responses are reversed to make consistent interpretations that the lowest scale is the least risk averse and the highest scale is the most risk averse. Communalities indicate the reliability of the factor variable presenting the percentage of variance of each question explained by the factor, and factor loadings are the measure of correlation coefficients between each risk preference question and the factor variable.

Risk Preference Questions	**Mean**	**Median**	**S.D**	**Communalities**	**Factor Loadings**
R1) I think it is more important to have safe investments and guaranteed returns than to take a risk to have a chance to get the highest possible returns.	5.20	6	1.59	0.411	0.641
R2) I would never consider investments in shares because I find this too risky.	4.25	4	2.02	0.456	0.675
R3) If I think an investment will be profitable; I am prepared to borrow money to make this investment. **[R]**	5.70	6	1.56	0.277	0.526
R4) I want to be certain that my investments are safe.	5.47	6	1.27	0.360	0.600
R5) I get more and more convinced that I should take greater financial risks to improve my financial position. **[R]**	5.07	5	1.70	0.327	0.572
R6) I am prepared to take the risk to lose money, when there is also a chance to gain money. **[R]**	5.25	6	1.55	0.608	0.779

Both mean and median values of individuals' expectation in 2005 are significantly lower than those of any other year at the 1% level of significance (two-tailed). However, the differences between 2004 and 2006 are not significant. We observe that individuals' expected stock market returns are much lower than the historical averages. The geometric average annual rate of return calculated from the AEX total return index over 1983-2006 is 14.1%, and that from the MSCI World total return is 11.4%. In particular, the geometric average annual rate of returns, calculated from the AEX and MSCI World total return indices, are 13.75% and 13.53% respectively for our survey period of 2004-2006. Thus our findings reinforce those of Hurd *et al*. (2011) as to the pessimistic views regarding the stock market held by Dutch individuals.

Following Dominitz and Manski (2007), we also account for individuals' perceptions as to the existence of an equity premium, in addition to the particular magnitude of their expectations. From the distribution of individuals' responses, we observe that only about fifty per cent of individuals recognise a premium for holding stocks. The percentages of respondents who expect positive returns from stock markets over the years 2004, 2005, and 2006 are 53%, 43%, and 60%, respectively. Over the period as a whole, the percentage of positive expectations increases.

To test whether or not there is a significant shift to more optimistic views in 2006, we undertake a binomial probability test. Our test result confirms that the probability of positive expectations in 2006 is significantly higher than in 2004 at the 1% level. The percentage of positive expectations in 2005 is significantly lower than in any other year at the 1% level. A significant drop both in the percentage of individuals expecting positive returns, as well as in the magnitude of returns expected in 2005 indicates that individuals' expectations are affected strongly by the most recent stock

market performance prior to the dates when the survey was executed. Figure 3 indicates that individuals' responses are obtained immediately following a small decline in stock prices. This supports the arguments of De Bondt (1993, 1998) and Graham and Harvey (2001) to the effect that individuals' expectations are influenced strongly by their recent experiences.

By comparing both the mean and median values each year, Table 9 also shows that investors expect significantly higher stock market returns than do non-investors. This systematic difference in expectations between investors and non-investors highlights the issue of causality between stock market expectations and stock ownership. Investors may hold higher expectations as to stock market returns because of their 'wishful expectations' (Ito, 1990), or, alternatively, these expectations may reflect factors such as familiarity with recent stock market history and belief in the existence of an equity premium. We therefore treat the stock market expectations variable as endogenous in order to better understand the direction of the relationship.

4.3.3 Measuring Risk Aversion

We measure risk aversion of individuals based on six questions available from the DHS, which evaluate individuals' risk preferences in terms of investment strategy. Table 10 (pp.104) presents descriptive statistics including values of mean, median and standard deviations from individuals' responses on six questions (R1-R6) over three years. Individuals indicate whether or not they agree or disagree with six statements such as, "*I think it is more important to have safe investments and guaranteed returns than to take a risk to have a chance to get the highest possible returns*" on a scale from 1 (totally disagree) to 7 (totally agree). Questions R1, R2, and R4 are concerned with the strength of individuals' preferences for safe investments while questions R3, R5,

and R6 are concerned with individuals' appetite for incurring risk in order to maximise possible profits. Individuals' responses to questions R3, R5, and R6 are therefore reversed in order to ensure that, in the case of all questions, the lowest point on the scale represents the least risk averse while the highest point on the scale represents the most risk averse.

We elicit the risk aversion of individuals by a relatively simple application of factor analysis to survey responses, taking the same approach as in Kapteyn and Teppa (2011). Including all six questions, a Principal Components Analysis (PCA) estimate is undertaken, applying the extraction method to create one factor variable. We report communalities and factor loadings from each risk preference question in Table 10. Communalities indicate the reliability of the factor variable in terms of the percentage of variance of each question explained by the factor. Factor loadings are the measure of correlation coefficients between each risk preference question, i.e. each component of the factor variable, and the factor variable estimated from the PCA[30]. The risk aversion factor variable has a mean of zero and a variance of one, which correlates more than 50% with the responses for each of the six questions.

Kapteyn and Teppa (2011) argue that eliciting risk aversion by the relatively simple approach of factor analysis through utilising survey responses is more powerful than that of Barsky *et al*. (1997) and Kimball *et al*. (2007) which is based on complex economic theory. Barsky *et al.* (1997) develop a hypothetical question which estimates respondents' willingness to take a gamble on a 50:50 chance of either doubling their current income or having it reduced by a third. Kimball *et al.* (2007) extend the scenarios further by incorporating varying levels of downside risk. Risk aversion measures which estimate individuals' attitudes towards gambles over their lifetime

[30] For more information, please refer to Jolliffe (2005) on Principal Component Analysis.

income are, however, affected by the level of risk inherent in their current portfolios. For example, individuals who hold risky portfolios will avoid betting on a safe income stream. Likewise, those who hold safe portfolios are likely to consider taking gambles over their income (Kapteyn and Teppa, 2011). Given the possibility of such outcomes, these risk aversion measures are misleading as measures of the true risk aversion of individuals.

Since different measures of risk aversion give rise to variations in their validity and predictive power, it is important to acknowledge that results are sensitive to different measures. In particular, after comparing different risk aversion measures in their study of subjective measures of risk aversion, Kapteyn and Teppa (2011) argue that the measures suggested by Barsky *et al*. (1997) have little explanatory power. Both Kézdi and Willis (2009) and Hurd *et al.* (2011), however, estimate individuals' risk aversion on the basis of survey responses to hypothetical gambles over lifetime income, developed respectively by Kimball, Sahm and Shapiro (2007) and Barsky *et al*. (1997). Thus, the findings of Kézdi and Willis (2009) and Hurd *et al.* (2011) that risk aversion has only a limited effect on individuals' stock market returns expectations and that individuals' stock market expectations alone explain the stock holding puzzle adequately, require careful interpretation and further validation by the application of a more powerful risk aversion measure.

In order to test whether the risk aversion factor captures the heterogeneity among individuals, we run a cross-sectional pooled linear regression by developing the following equation (4.1).

$$(4.1) \qquad Risk_{\mathrm{i,t}} = \alpha + \beta \mathrm{x'_{i,t}} + \delta \mathrm{z'_{t}} + \varepsilon_{i,t}$$

$$\varepsilon_{i,t} \sim N(0, \sigma_{\varepsilon}^{2})$$

The dependent variable, $Risk_{\mathrm{i,t}}$, denotes an individual i' risk aversion factor in terms of decimal at time t. $\mathrm{x}'_{\mathrm{i,t}}$ is the sum of vectors of demographical and financial characteristics measured for each year including gender, marital status, age group, education level, employment status, house ownership status, financial assets and net worth. z'_{t} is a vector of year dummies. α is a constant. $\varepsilon_{i,t}$ is a normally distributed error term with a mean of zero. The standard errors are clustered by individuals and are robust to heteroskedasticity.

In Table 11, we denote an expected sign, i.e. negative or positive, for the coefficient of each independent variable with regard to its relationship with the dependent variable, the risk aversion factor. Due to high collinearity between age group and employment status, and between financial assets and net worth quartiles,[31] in addition to the full model (1), we present regressions (2) – (5) which exclude each categorical variable which is subject to multicollinearity. Our results presented in Table 11 support the previous research findings of Barsky *et al*. (1997) and Kapteyn and Teppa (2011) that individuals' hold heterogeneous risk preferences. Females and older individuals are much more risk averse than males and younger individuals. More

[31] From the full model (1) in Table 11, we obtain the mean Variance Inflation Factor (VIF) of 1.95, and the highest VIF value of 3.99 from the age group category, 65<Age. Although these values are much lower than the rule of the thumb value of 10 for severe multicollinearity within the model (O'Brien, 2007), there are significant relationships between age group and employment status, and also between financial assets and net worth quartiles according to the Pearson Chi-squared tests summarised below. Thus, we exclude each variable from regressions (2) – (5) to determine whether the collinearity of these variables affects the magnitude of coefficients and the significance levels of other variables.

	Employment Status					
Age	**Regular**	**Self-employed**	**Retired**	**Unemployed**	**Others**	**Total**
35 and Less	416	36	0	68	16	536
36≤Age ≤50	643	50	0	93	40	826
51≤Age ≤65	533	39	175	146	139	1,032
65<Age	3	4	470	58	27	562
Total	1,595	129	645	365	222	2,956
			Pearson chi2(12) = 1800.00 Pr = 0.000			

	Net Worth				
Financial asset	1	2	3	4	Total
1	479	100	110	49	738
2	230	230	193	86	739
3	26	319	223	172	740
4	3	92	213	431	739
Total	738	741	739	738	2,956
Pearson chi2(9) = 1500.00 Pr = 0.000					

educated individuals are relatively less risk averse. Self-employed individuals are less risk averse, while retired individuals are more risk averse than those in regular employment. Individuals whose holdings of financial assets fall within the upper quartiles are less risk averse than those whose holdings occupy the lowest quartile of the distribution, confirming a significant wealth effect. The opposite signs from the holdings of net worth observed in regression (1)–(3) disappear when financial assets quartiles are omitted from regression (5), which indicate that there are no variations between the upper quartiles of net worth and the lowest quartile of the distribution (an absence of significant variation of risk aversion is also observed in the univariate test).

Although Hoffmann, Post and Pennings (2013) find that individuals' risk tolerance and perception fluctuate over time in a similar fashion to their stock market expectations, we do not observe a significant year effect. Our findings indicate that the risk aversion levels of individuals remains stable during the survey period which covers a relatively buoyant market period. The relationship between individuals' risk aversion factors and their stock market return expectations is significantly negative with a Pearson correlation coefficient of - 12.84% (at the 0% significance level, two-tailed).

In order to investigate the interactions between individuals' stock market expectations and risk aversion, we create a dummy variable which determines high and low levels of risk aversion for the factor variable at a cut-off point of zero. Within the sample period, about 20% of individuals move from the low to the high level of risk aversion, while about 20% move from high to low. Again, our sample results demonstrate that most, although not all, individuals remain at the same risk aversion level over time. Overall, our measure of risk aversion captures significant heterogeneity systematically reflecting individuals' demographical and financial backgrounds.

Table 11 Heterogeneity in Individuals' Risk Aversion

From 2956 observations from 1587 individuals, we present OLS regression results. The dependent variable is stock market return expectations. Our standard errors are clustered by each individual and robust to heteroskedasticity. The significance level is defined by the two-tailed p-values of 1%***, 5%**, and 10%*.

		(1)		(2)		(3)		(4)		(5)	
Risk Aversion Factor (decimal)	–/+	Coef.	T	Coef.	T	Coef.	T	Coef.	T	Coef.	T
Female	+	0.488***	(8.81)	0.484***	(9.37)	0.494***	(8.87)	0.460***	(8.55)	0.479***	(8.64)
Married	+	0.013	(0.23)	0.029	(0.52)	0.013	(0.23)	0.005	(0.08)	0.016	(0.28)
36≤ Age ≤50	+	0.085	(1.25)	0.085	(1.25)			0.103	(1.52)	0.068	(1.00)
51≤ Age ≤65	+	0.286***	(3.89)	0.329***	(4.57)			0.310***	(4.32)	0.261***	(3.59)
65<Age	+	0.321***	(3.08)	0.535***	(6.69)			0.349***	(3.39)	0.298***	(2.87)
Education *(High)*	−	-0.090*	(-1.79)	-0.090*	(-1.80)	-0.123***	(-2.50)	-0.086*	(-1.72)	-0.105**	(-2.10)
Self-employed	−	-0.233**	(-2.28)			-0.243**	(-2.42)	-0.235**	(-2.31)	-0.284***	(-2.81)
Retired	+	0.243***	(2.72)			0.399***	(6.31)	0.242***	(2.70)	0.238***	(2.65)
Unemployed	+	0.111	(1.36)			0.170**	(2.15)	0.102	(1.24)	0.106	(1.30)
Other occupations	−	-0.067	(-0.69)			0.036	(0.38)	-0.069	(-0.71)	-0.058	(-0.59)
House owners	−	-0.070	(-1.11)	-0.065	(-1.02)	-0.091	(-1.43)	-0.013	(-0.22)	-0.037	(-0.58)
Financial assets *(Q_2)*	−	-0.034	(-0.56)	-0.035	(-0.58)	-0.019	(-0.32)	-0.001	(-0.01)		
Financial assets *(Q_3)*	−	-0.117*	(-1.72)	-0.127*	(-1.87)	-0.086	(-1.28)	-0.054	(-0.87)		
Financial assets *(Q_4)*	−	-0.280***	(-3.53)	-0.293***	(-3.73)	-0.249***	(-3.14)	-0.204***	(-2.84)		
Net worth *(Q_2)*	−	0.099	(1.49)	0.090	(1.35)	0.106	(1.59)			0.018	(0.29)
Net worth *(Q_3)*	−	0.158**	(2.06)	0.152**	(1.96)	0.207***	(2.71)			0.038	(0.52)
Net worth *(Q_4)*	−	0.158*	(1.82)	0.162*	(1.85)	0.239***	(2.77)			-0.028	(-0.36)
Year 2005	+	0.038	(1.24)	0.039	(1.24)	0.043	(1.37)	0.039	(1.27)	0.038	(1.24)
Year 2006	−	-0.011	(-0.33)	-0.010	(-0.28)	0.002	(0.06)	-0.013	(-0.38)	-0.010	(-0.31)
Constant		-0.332***	(-3.69)	-0.342***	(-3.82)	-0.225***	(-2.70)	-0.317***	(-3.59)	-0.339***	(-3.85)
R-squared		0.099		0.091		0.089		0.097		0.092	

4.3.4 Other Behavioural factors

We identify other behavioural factors which influence both individuals' stock market expectations and portfolio allocation decisions. In Appendix B, we present both survey questions and mean values for the dummy variables. In responding to the DHS, individuals are requested to indicate as to how knowledgeable they consider themselves to be with regard to financial matters. It has been documented that investors of higher financial literacy are able to undertake more advanced economic evaluations (Van Rooij, Lusardi, and Alessie, 2011; 2012). Based on individuals' self-evaluated financial knowledge levels, we identify whether those who believe themselves to be highly knowledgeable investors form their expectations and investment decisions differently from those who perceive themselves as the opposite.

Additionally, we assess whether individuals' expectations vary depending on the source of advice they receive, broadly categorised as (1) parents and friends, (2) the media, (3) professional advisers, and (4) others. Canner, Mankiw, and Weil (1997) point out that disclosure of individuals' most important financial sources of advice reveals the most important influences on them when forming expectations. According to Shiller (1990), investors' mental frames are shared socially, and easily manipulated by the news media, discussions with families and friends, and recommendations from financial advisors. Similarly, De Bondt (1998) states that investors' seemingly irrational behaviour reflects the popular financial advice they receive, arguing that many individuals make investment decisions which lack rigorous consideration, being based on impulse or on random tips from acquaintances. Furthermore, De Bondt (1998) argues that those investors who rely on the most informal advice tend to be more pessimistic in their attitude to risk. In contrast, those who receive advice from professional finance advisors are more likely to be investors.

4.4 Empirical Results

4.4.1 Risk Aversion on Stock Market Expectations

In order to test our first hypothesis that individuals' stock market expectations are affected negatively by risk aversion, we develop the following equation (4.2).

$$(4.2) \qquad Ex_{i,t} = \alpha + RA_{i,t} + \beta x'_{i,t} + \gamma y'_{i,t} + \delta z'_{t} + \varepsilon_{i,t}$$

$$\varepsilon_{i,t} \sim N(0, \sigma_{\varepsilon}^2)$$

The dependent variable, $Ex_{i,t}$, denotes an individual *i*' stock market expectation in terms of percentage (%) at time *t*. $RA_{i,t}$ is a dummy variable for risk aversion. $x'_{i,t}$ is the sum of vectors of demographical and financial characteristics measured for each year including gender, marital status, age group, education level, employment status, house ownership status, financial assets and net worth. $y'_{i,t}$ is the sum of vectors of behavioural factors including self-evaluated financial knowledge level, and source of most important financial advice. z'_{t} is a vector of year dummies. α is a constant. $\varepsilon_{i,t}$ is a normally distributed error term with a mean of zero. The standard errors are clustered by individuals and are robust to heteroskedasticity.

Table 12 presents five estimation results based on our equation. We denote an expected sign, i.e. negative or positive for the coefficient of each independent variable with regard to the relationship with individuals' stock market return expectations. Regression (1) presents the full model, and due to high collinearity between age group and employment status, and between financial assets and net worth quartiles, we present regressions (2) – (5) which exclude each categorical variable, included in the full model, which is subject to multicollinearity.

We observe significant and negative effects arising from individuals' risk aversion levels which results in them holding negative stock market expectations

consistent with our first hypothesis. We observe a highly significant gender effect in that females expect much lower stock market returns than males, consistent with the finding of Hurd *et al.* (2011) that females are much more pessimistic than males. Individuals with higher levels of education hold higher stock market expectations, and those who are over 65 hold more negative expectations than those aged less than 36. In regression (2) in Table 12, where employment status is excluded, the age effects become more significant (at the 5% level, two-tailed). Likewise in regression (3), those individuals who are retired hold significantly negative stock market return expectations (at the 0% level, two-tailed). With regard to regressions (4) and (5), individuals with higher financial assets and who fall within higher net worth quartiles expect significantly higher stock market returns than those within the lowest quartile.

The effect of individuals' self-evaluated financial knowledge level is significant. Those with higher levels of self-evaluated financial knowledge hold higher expectations than those perceiving themselves as less knowledgeable. The effect of the most important source of financial advice is also significant. Compared to those who rely on the most informal source of advice, i.e. advice from families and friends, individuals who receive advice from the media, professional financial advisors, and other sources expect significantly higher returns. With regard to year dummies, we observe that individuals' stock market expectations in year 2005, but not in year 2006, are significantly lower than in year 2004, as discussed previously.

In support of our first hypothesis, we conclude that individuals' stock market return expectations are heterogeneous, and this heterogeneity is determined significantly by their levels of risk aversion, as well as changes in their expectations over time, while also reflecting significant effects arising from other control variables including demographical, financial, and behavioural factors in the model.

Table 12 Heterogeneity in Stock Market Return Expectations

From 2956 observations from 1587 individuals, we present OLS regression results. The dependent variable is stock market return expectations. Our standard errors are clustered by each individual and robust to heteroskedasticity. The significance level is defined by the two-tailed p-values of 1%***, 5%**, and 10%*.

		(1)		(2)		(3)		(4)		(5)	
Stock Market Expectations (%)	−/+	Coef.	T	Coef.	T	Coef.	T	Coef.	T	Coef.	T
Risk Aversion (1-High)	−	-0.845***	(-2.90)	-0.852***	(-2.96)	-0.875***	(-3.02)	-0.833***	(-2.85)	-0.863***	(-2.97)
Female	−	-1.458***	(-4.04)	-1.401***	(-4.26)	-1.481***	(-4.07)	-1.582***	(-4.70)	-1.431***	(-3.98)
Married	+	0.188	(0.52)	0.225	(0.64)	0.217	(0.60)	0.142	(0.39)	0.183	(0.50)
36≤ Age ≤50	−	-0.025	(-0.05)	-0.045	(-0.09)			0.053	(0.11)	0.026	(0.05)
51≤ Age ≤65	−	-0.510	(-1.07)	-0.590	(-1.26)			-0.417	(-0.90)	-0.440	(-0.93)
65<Age	−	-1.077*	(-1.74)	-1.190**	(-2.34)			-0.975	(-1.61)	-1.009*	(-1.64)
Education *(High)*	+	0.522*	(1.69)	0.516*	(1.71)	0.588**	(1.95)	0.533*	(1.74)	0.548*	(1.76)
Self-employed	+	0.751	(0.93)			0.745	(0.92)	0.752	(0.93)	0.861	(1.07)
Retired	−	-0.067	(-0.14)			-0.739***	(-2.19)	-0.077	(-0.17)	-0.061	(-0.13)
Unemployed	−	0.269	(0.46)			0.074	(0.13)	0.223	(0.38)	0.286	(0.49)
Other occupations	−	-0.425	(-0.65)			-0.679	(-1.06)	-0.425	(-0.65)	-0.441	(-0.69)
House owners	+	0.369	(0.87)	0.373	(0.88)	0.425	(1.00)	0.630	(1.58)	0.291	(0.68)
Financial assets *(Q_2)*	+	-0.004	(-0.01)	0.038	(0.10)	-0.042	(-0.10)	0.193	(0.48)		
Financial assets *(Q_3)*	+	0.373	(0.83)	0.438	(0.99)	0.310	(0.69)	0.732*	(1.83)		
Financial assets *(Q_4)*	+	0.596	(1.24)	0.687	(1.45)	0.533	(1.12)	0.974**	(2.31)		
Net worth *(Q_2)*	+	0.633	(1.40)	0.626	(1.38)	0.627	(1.38)			0.853**	(2.07)
Net worth *(Q_3)*	+	0.839*	(1.65)	0.815	(1.60)	0.756	(1.50)			1.130**	(2.42)
Net worth *(Q_4)*	+	0.748	(1.30)	0.726	(1.26)	0.578	(1.02)			1.181**	(2.40)
Knowledge Level *(More or Less)*	+	1.250***	(3.03)	1.240***	(2.99)	1.268***	(3.06)	1.270***	(3.08)	1.270***	(3.05)
Knowledge Level *(High)*	+	1.731***	(3.57)	1.745***	(3.61)	1.773***	(3.65)	1.739***	(3.59)	1.777***	(3.67)
Advice *(Media)*	+	0.755**	(2.07)	0.738**	(2.02)	0.655*	(1.82)	0.777**	(2.13)	0.756**	(2.07)
Advice *(Professional Advisor)*	+	0.975***	(2.55)	0.989***	(2.59)	0.923**	(2.43)	1.001***	(2.63)	0.987***	(2.58)
Advice *(Others)*	+	1.180*	(1.85)	1.165*	(1.83)	1.076*	(1.72)	1.155*	(1.81)	1.166*	(1.82)
Year 2005	−	-1.355***	(-5.20)	-1.355***	(-5.20)	-1.371***	(-5.28)	-1.351***	(-5.19)	-1.355***	(-5.20)
Year 2006	+	0.159	(0.56)	0.164	(0.58)	0.133	(0.47)	0.154	(0.54)	0.157	(0.56)
Constant		1.715***	(2.21)	1.715**	(2.26)	1.609**	(2.20)	1.815**	(2.38)	1.686**	(2.26)
R-squared		0.066		0.065		0.065		0.065		0.065	

4.4.2 Stock Market Expectations and Stock Market Participation Decisions

In order to test our second hypothesis, we investigate the combined effect of stock market expectations and risk aversion on individuals' stock market participation decisions. We create a Linear Probability Model (LPM) based on the OLS regression where the estimates of the independent variables are interpreted as the probability of stock market participation as shown below in equation (4.3).

$$(4.3) \qquad S_{\mathrm{i,t}} = \alpha + Ex_{i,t} + RA_{i,t} + Ex_{i,t} \times RA_{i,t} + \beta \mathrm{x'_{i,t}} + \gamma \mathrm{y'_{i,t}} + \delta \mathrm{z'_{t}} + \varepsilon_{i,t}$$

$$\varepsilon_{i,t} \sim N\,(0, \sigma_{\varepsilon}^{2})$$

The dependent variable is a qualitative dichotomous variable, describing individuals' stock market participation decisions. $S_{\mathrm{i,t}}$, stands for 1, if individual *i* holds any risky financial assets at time *t*, otherwise 0. We include individuals' stock market expectations in terms of percentage, $Ex_{i,t}$, and risk aversion dummy, $RA_{i,t}$, as explanatory variables, as well as their interactions. The remaining variables and controls for the standard errors are the same as for equation (4.2).

In Panel A of Table 13, we present OLS (1) model from the linear probability estimations and two instrumental variable (IV) estimates, GMM (1) and GMM (2). As proposed by Hansen (1984), we apply the Generalised Methods of Moments (GMM) to control for unknown forms of heteroskedasticity within our linear regression models with IV estimators to produce efficient and consistent estimations[32]. In Table 13, we only report the full models from three estimations, as the estimates of the explanatory variables are unaffected by the multicollinearity within the model, and next to each independent variable, we denote an expected sign for the coefficient.

[32] To correct for intra group correlations in the IV estimates, we cluster standard errors by individuals as specified by Wooldridge (2002, pp.193). For further discussion, see Hayashi (2000, pp. 227-228, 407, and 417), and for the application of the model, see Baum, Schaffer, and Stillman (2003), and Baum (2006, Chapter 8. Instrumental-variables estimators).

The LPM model with the binary dependent variable faces several potential problems as it violates the OLS assumptions[33]. Nevertheless, we base our estimates on this model so as to enable comparison with the instrumental variable (IV) with GMM estimates. When we compare the reported OLS (1) model with the marginal effects after the Probit model (not reported), however, the sign, size and significant levels of most coefficients are very similar. Aldrich and Nelson (1984) note that the LPM tends to provide the correct signs for the relationships between the independent and dependent variables; nevertheless its distributional properties and statistical inferences cannot be justified theoretically.

From OLS (1) model in Panel A Table 13, we observe positive and significant effects from stock market return expectations and also negative and significant effects from risk aversion. However the interactions of these two variables are not significant. The magnitude of the coefficient of stock market expectations is very small; a 1% increase in expectations increases stock market participation only by 0.8%. Since we recognise the problem of endogeneity when determining the influence of stock market expectations on stock market participation, the OLS (1) estimates of the effect of stock market expectations are likely to be biased and unreliable.

Individuals' stock market expectations are influenced by the closeness with which they follow the market and their awareness of, and familiarity with, market history. Thus individuals' expectations are also affected by their stock market participation. Stock market returns expectations of those individuals who have no experience of holding stocks may be based on mere speculation reflecting poor quality

[33]Aldrich and Nelson (1984) identify several problems with the LPM. Firstly, the assumption in the LPM that all disturbances have the same variance (the residuals are subject to heteroskedasticity) casts doubt on the validity of standard errors. Secondly, the residuals in the LPM are not normally distributed. Thirdly, in the LPM there is no linear relationship between the independent and dependent variables. Fourthly, in the LPM the probabilities can range outside the range 0 to 1 since the predicted value in OLS can assume infinite values in both negative and positive directions.

information and confidence. Also, stock market expectations are likely to be correlated with other unobserved variables influencing stock market participation, including factors such as personal experiences of economic fluctuations (Malmendier and Nagel, 2011), individuals' information sets which reflects their preceding stock market expectations (Arrondel *et al.*, 2012), and varying levels of cognitive capacity (Christelis *et al.*, 2010) which we are unable to identify due to the non-availability of the data.

To account for the issues of causality affecting our results, we include additional variables as instruments in order to apply instrumental variables (IV) estimations. The first instrument we consider is *individuals' expectations as to their own financial situation a year ahead* and, in particular, whether it will 'improve', 'stay the same', or 'deteriorate'. According to Vissing-Jørgensen (2003), individuals' expectations reflect their own particular situations. Thus we believe that individuals form stock market expectations based on their expectations as to their own financial situations.

The second instrument which we consider is *individuals' investment horizons*; more specifically, whether an individual's most important time-horizon with regard to planning expenditures and savings is 'a couple of months', 'the next year', 'the next couple of years', or 'more than five years'. Differing investment horizons lead to individuals holding distinctive attitudes towards different assets, which in turn influence stock market expectations. In Appendix B, we present the survey questions and mean values for both categorical dummy instruments. In terms of our model, consideration of stock market expectations as an endogenous variable implies that the related interaction term with risk aversion is also endogenous. Thus, we control for two endogenous variables in our model. To account for the endogenous interaction term, we include additional instruments created by multiplying the risk aversion dummy with our two categorical dummy instruments.

Table 13 Stock Market Expectations and Stock Market Participation

Panel A - Comparison between the OLS and GMM models

We present a linear probability model OLS (1) and second stages of IV estimates with GMM estimators GMM (1) and GMM (2). In GMM (1), we include as the only instrument, individuals' expectation as to their own financial situations, while in GMM (2) we also include investment horizon as an instrument in the first-stage regressions. The dependent variable takes a value of 1 if individuals own any risky financial assets; otherwise, it takes a value of zero. In the report of P-value exogeneity tests, Ex stands for stock market expectations, and Ex'RA stands for the interactions between stock market expectations and risk aversion. Our standard errors are clustered by individuals and robust to heteroskedasticity. The significance level is defined by the two-tailed p-values of 1%***, 5%**, and 10%*.

		OLS (1)		**GMM (1)**		**GMM (2)**	
Stock Market Participation	–/+	Coef.	T	Coef.	Z	Coef.	Z
Stock Market Expectation	+	0.008***	(4.49)	0.055***	(4.46)	0.043***	(3.76)
Risk Aversion (1-High)	−	-0.184***	(-9.47)	-0.073	(-1.30)	-0.107**	(-2.19)
Risk Aversion X Expectation	−	-0.003	(-1.11)	-0.027*	(-1.77)	-0.022*	(-1.67)
Female	−	0.018	(0.75)	0.061**	(2.12)	0.049*	(1.77)
Married	−	-0.016	(-0.64)	-0.017	(-0.58)	-0.005	(-0.20)
36≤ Age ≤50	+	0.075***	(2.75)	0.083***	(2.49)	0.097***	(3.02)
51≤ Age ≤65	+	0.014	(0.49)	0.039	(1.13)	0.032	(0.96)
65<Age	+	0.064	(1.43)	0.102**	(2.03)	0.092*	(1.88)
High level education	+	0.074***	(3.33)	0.056**	(2.21)	0.066***	(2.67)
Self-employed	+	0.216***	(4.32)	0.196***	(3.12)	0.199***	(3.32)
Retired	−	-0.010	(-0.28)	-0.007	(-0.19)	-0.006	(-0.16)
Unemployed	−	0.031	(0.99)	0.033	(0.93)	0.027	(0.77)
Other occupations	−	0.084**	(2.29)	0.126***	(2.72)	0.101**	(2.40)
House owners	−	-0.034	(-1.25)	-0.049	(-1.53)	-0.055*	(-1.78)
Financial assets *(Q_2)*	+	0.154***	(6.92)	0.153***	(5.45)	0.142***	(5.45)
Financial assets *(Q_3)*	+	0.317***	(10.84)	0.301***	(8.80)	0.316***	(9.56)
Financial assets *(Q_4)*	+	0.549***	(16.89)	0.523***	(13.51)	0.548***	(15.13)
Net worth *(Q_2)*	+	0.005	(0.18)	-0.027	(-0.81)	-0.014	(-0.42)
Net worth *(Q_3)*	+	0.015	(0.48)	-0.023	(-0.60)	-0.001	(-0.02)
Net worth *(Q_4)*	+	0.009	(0.24)	-0.028	(-0.63)	-0.027	(-0.63)
Knowledge Level *(More or Less)*	+	0.033	(1.28)	-0.002	(-0.05)	0.013	(0.45)
Knowledge Level *(High)*	+	0.095***	(3.04)	0.039	(0.99)	0.068*	(1.83)
Advice *(Media)*	+	0.064***	(2.82)	0.033	(1.22)	0.037	(1.43)
Advice *(Professional Advisor)*	+	0.077***	(3.22)	0.035	(1.19)	0.040	(1.40)
Advice *(Others)*	+	0.051	(1.41)	-0.005	(-0.10)	0.005	(0.13)
Year 2005		0.028	(2.41)	0.073***	(3.64)	0.066***	(3.45)
Year 2006		0.013	(0.90)	0.005	(0.28)	0.020	(1.16)
Constant		-0.025	(-0.58)	-0.134**	(-2.17)	-0.120**	(-2.17)
R-squared			0.3319		0.3850		0.4920
N of Observations			2956		2939		2640
N of Individuals			1587		1579		1426

Underidentification test: P-value of Kleibergen-Paap rk LM statistics, Chi-sq (3)	0.000	0.000
Overidentification test: P-value of Hansen J-statistic, Chi-sq (2)	0.9095	0.4461
Endogeneity test: P-value on Ex, Chi-sq (1)	0.00	0.00
Endogeneity test: P-value on Ex'RA, Chi-sq (1)	0.022	0.09
Exogneity test: P-value of C statistic on Risk Aversion, Chi-sq (1)	0.69	0.19
Exogneity test: P-value of C statistic on Future Expectations Instruments, Chi-sq (2)	0.91	0.37
Exogneity test: P-value of C statistic on Horizon Instruments Chi-sq (3)		0.21

Panel B - First-Stage Regressions of GMM estimates

We present first-stage regression results from the GMM (1) and GMM (2) models. F-statistics are cluster robust, and our standard errors are clustered by individuals and robust to heteroskedasticity. The significance level is defined by the two-tailed p-values of 1%***, 5%**, and 10%*.

First-Stages	**GMM(1) – First-Stages**				**GMM (2) – First-Stages**			
	Expectation (Ex)		Interaction (Ex'RA)		Expectation (Ex)		Interaction (Ex'RA)	
	Coef.	T	Coef.	T	Coef.	T	Coef.	T
Risk Aversion (1-High)	-0.562	(-0.90)	5.183***	(10.73)	0.124	(0.14)	6.220***	(8.64)
Female	-1.277***	(-3.66)	-0.725***	(-2.93)	-1.330***	(-3.56)	-0.800***	(-3.00)
Married	0.359	(1.02)	0.492**	(2.08)	0.446	(1.22)	0.473*	(1.90)
36≤ Age ≤50	0.213	(0.46)	0.191	(0.65)	-0.125	(-0.25)	-0.099	(-0.31)
51≤ Age ≤65	0.259	(0.55)	0.343	(1.11)	-0.084	(-0.16)	-0.040	(-0.12)
65<Age	-0.205	(-0.34)	0.020	(0.05)	-0.525	(-0.82)	-0.379	(-0.87)
High level education	0.307	(1.03)	0.024	(0.12)	0.068	(0.22)	-0.108	(-0.51)
Self-employed	0.243	(0.32)	0.370	(0.67)	0.235	(0.29)	0.444	(0.73)
Retired	-0.102	(-0.22)	-0.124	(-0.42)	-0.019	(-0.04)	0.122	(0.39)
Unemployed	0.131	(0.25)	0.041	(0.10)	0.053	(0.10)	0.113	(0.27)
Other occupations	-0.437	(-0.69)	0.476	(1.14)	-0.438	(-0.67)	0.563	(1.31)
House owners	0.221	(0.54)	-0.048	(-0.18)	0.139	(0.32)	-0.122	(-0.43)
Financial assets *(Q_2)*	-0.033	(-0.08)	-0.060	(-0.23)	-0.042	(-0.10)	-0.042	(-0.15)
Financial assets *(Q_3)*	0.359	(0.81)	0.218	(0.74)	0.093	(0.20)	0.036	(0.12)
Financial assets *(Q_4)*	0.341	(0.74)	-0.162	(-0.56)	0.091	(0.18)	-0.251	(-0.82)
Net worth *(Q_2)*	0.682	(1.55)	0.057	(0.21)	0.785*	(1.64)	0.104	(0.36)
Net worth *(Q_3)*	0.932*	(1.89)	0.368	(1.21)	1.119**	(2.13)	0.574*	(1.82)
Net worth *(Q_4)*	0.915*	(1.64)	0.339	(0.91)	1.141*	(1.92)	0.549	(1.44)
Knowledge Level *(More or Less)*	1.056***	(2.59)	0.846***	(2.88)	1.249***	(2.97)	0.947***	(2.94)
Knowledge Level *(High)*	1.331***	(2.78)	0.837***	(2.52)	1.376***	(2.78)	0.860**	(2.40)
Advice *(Media)*	0.814**	(2.30)	0.300	(1.19)	0.915***	(2.46)	0.361	(1.35)
Advice *(Professional Advisor)*	0.947***	(2.54)	0.196	(0.75)	1.165***	(2.97)	0.298	(1.08)
Advice *(Others)*	1.010	(1.62)	-0.199	(-0.43)	1.125*	(1.78)	0.113	(0.23)
Year 2005	-1.233***	(-4.79)	-0.741***	(-3.97)	-1.371***	(-5.01)	-0.754***	(-3.73)
Year2006	0.216	(0.76)	0.069	(0.36)	-0.061	(-0.21)	-0.044	(-0.22)
Future Expectation *(Stay the same)*	-2.385***	(-5.40)	0.062	(0.75)	-2.466***	(-5.32)	0.091	(1.04)
Future Expectation *(Will deteriorate)*	-3.106***	(-5.20)	0.061	(0.52)	-2.884***	(-4.44)	0.101	(0.82)
Future'RA *(Stay the same)*	0.004	(0.01)	-2.432***	(-4.66)	0.263	(0.37)	-2.345***	(-4.32)
Future'RA *(Will deteriorate)*	-0.501	(-0.61)	-3.773***	(-6.27)	-0.765	(-0.87)	-3.896***	(-6.20)
Horizon *(Next year)*					0.490	(0.86)	-0.161**	(-2.06)
Horizon *(Next couple of year)*					0.493	(0.99)	-0.175*	(-1.87)
Horizon *(More than five years)*					0.549	(0.93)	-0.132	(-1.25)
Horizon'RA *(Next couple of months)*					-0.962	(-1.12)	-1.823***	(-2.88)
Horizon'RA *(Next year)*					-1.135	(-1.33)	-1.225**	(-1.97)
Horizon'RA *(Next couple of years)*					-0.667	(-0.86)	-0.649	(-1.12)
Constant	3.345***	(3.99)	-1.327***	(-2.90)	3.270***	(3.46)	-1.035**	(-2.16)
F-statistics of instrument		16.74		9.89		6.48		4.58
R-squared		0.2722		0.1876		0.2782		0.1924
N of Observations		2939		2939		2640		2640
N of Individuals		1579		1579		1426		1426

In GMM (1), we include only the instrument, *individuals' expectations as to their own financial situations*, while in GMM (2) we also include *investment horizon* as an instrument. Both GMM (1) and GMM (2) models in Panel A of Table 13 indicate significant and positive effects arising from stock market expectations with coefficients of at least five times greater than that of the OLS (1) model.

With regard to our second hypothesis, both GMM models indicate negative interactions between stock market expectations and risk aversion. Although only significant at the 10% level (two-tailed), the results do not lead us to reject our hypothesis that the effect of stock market expectations on stock market participation decisions depends on the levels of risk aversion. This relationship is significant after controlling for other variables; the coefficients and significance levels of the other control variables in the GMM models are similar to those in the OLS (1) model, and are consistent with previous research findings identifying stockholders' characteristics.

We check the validity of our instruments following the interpretations of both first- and second-stage test statistics as in Baum, Schaffer, and Stillman (2010). From the first-stage regression results shown in Panel B of Table 13, we confirm that the instruments have strong predictive power for each endogenous variable. Both the significance of the coefficients in the first-stage regressions, and the cluster robust Angrist-Pischke (AP) first-stage *F*-statistics, lead to rejection of the null hypothesis that the endogenous variable is unidentified (Angrist and Pischke, 2009; pp. 217-18). The AP *F*-statistics for GMM (1) are 16.74 for stock market expectations, and 9.89 for the interaction term with risk aversion, respectively. These values are above or near to the 'rule of thumb' value of 10 for rejecting weak instruments (Staiger and Stock, 1997). However, the GMM (2) AP *F*-statistics are lower, equalling 6.28 and 4.58 for two endogenous variables; expectations and interactions, respectively.

The under-identification test for cluster-robust standard errors based on Kleibergen-Paap rk LM statistics (Kleibergen-Paap, 2006), [34] computed from the second-stage regressions of both GMM (1) and (2) in Panel A Table 13, leads to us to reject the null hypotheses that any endogenous variable is under-identified. The under-identification test establishes whether or not the instruments are 'relevant', identifying significant correlations with the endogenous variables (Kleibergen-Paap, 2006). The over-identification test for the presence of heteroskedasticity and autocorrelation (Hayashi, 2000; pp. 227-8, 407, 417) is based on Hansen's J statistic (Hansen, 1982). This test examines the validity of instruments, adopting the joint null hypothesis that both instruments are orthogonal, i.e. uncorrelated with the error term, and correctly excluded from the estimated equation (Baum, Schaffer, and Stillman, 2010). We confirm that the instruments included in both the GMM (1) and (2) models are relevant and valid as the tests fail to reject the null hypothesis.

We further apply both endogeneity tests to the two endogenous variables under the null hypothesis that the endogenous variable can actually be treated as exogenous, following Baum, Schaffer, and Stillman (2010). For each of our endogenous variables, the tests reject the null hypothesis confirming that we treated these variables correctly, confirming that the stock market expectations variable and its interactions with risk aversion are endogenous, and, in turn, that by applying IV estimates we obtain consistent coefficients. The C statistic for the orthogonality condition of instruments tests has the null hypothesis that the instruments are valid (Hayashi, 2000; pp. 218-22 and pp. 232-34). The orthogonality conditions of our instruments as well as the risk aversion dummy are confirmed as reported; all fail to reject the null hypothesis.

[34] Kleibergen-Paap rk LM statistics (Kleibergen-Paap, 2006) are reported instead of the Anderson canonical correlations likelihood-ratio test (Anderson, 1984) as the standard errors in the model are not assumed to be independently and identically distributed (i.i.d.).

4.4.3 Stock Market Expectations and Investors' Portfolio Allocation Decisions

In order to test our third hypothesis, we investigate whether the effect of heterogeneous stock market expectations on investors' portfolio allocation decisions varies as a function of their risk aversion. Only including investors in our sample, i.e. those individuals who hold risky financial assets in their financial portfolios, we develop the following model equation (4.4).

$$(4.4) \qquad Share_{\mathrm{i,t}} = \alpha + Ex_{i,t} + RA_{i,t} + Ex_{i,t} \times RA_{i,t} + \beta \mathrm{x'_{i,t}} + \gamma \mathrm{y'_{i,t}} + \delta \mathrm{z'_{t}} + \varepsilon_{i,t}$$

$$\varepsilon_{i,t} \sim N\,(0, \sigma_{\varepsilon}^{2})$$

The dependent variable, $Share_{\mathrm{i,t}}$, is the proportion of risky financial assets in the total financial assets held by investor *i* at time *t*. The remaining variables and controls for standard errors are the same as in equation (4.2). In Panel A of Table 14, we compare a linear regression model, OLS (2) with two GMM models (3) and (4)[35], using the same set of instruments as in the previous section. First-stage regressions of IV estimates are reported in Panel B of Table 14.

All three models indicate that there are significant and positive influences from investors' stock market expectations on the proportion of risky assets held in their financial portfolios, while risk aversion and the interactions between stock market expectations and risk aversion are not significant. Thus we reject our hypothesis relating to investors' portfolio allocation decisions. Once individuals have participated in the stock market, risk aversion ceases to play a role. The proportion allocated to risky assets in investors' financial portfolios, however, is determined by their expectations as to stock returns, and this positive relationship is significant. Consequently, our findings support Vissing-Jørgensen (2003) who finds that investors with higher stock market return expectations hold higher proportions of equity in their portfolios.

[35] In GMM (3), we include only the instrument, individuals' expectations as to their own financial situations, while in GMM (4) we also include investment horizon as an instrument.

Table 14 Stock Market Expectations and Investors' Portfolio Allocations

Panel A - Comparison between the OLS and GMM models

We present an OLS (2) model and second stages of IV estimates with GMM estimators, GMM (3) and GMM (4). In GMM (3), we include as the only instrument, individuals' expectation as to their own financial situations, while in GMM (4) we also include investment horizon as an instrument in the first-stage regressions. The dependent variable is investors' allocated share of risky financial assets from the total financial assets. In the report of P-value exogneity tests, Ex stands for stock market expectations, and Ex'RA stands for the interactions between stock market expectations and risk aversion. Our standard errors are clustered by individuals and robust to heteroskedasticity. The significance level is defined by the two-tailed p-values of 1%***, 5%**, and 10%*.

		OLS (2)		**GMM (3)**		**GMM (4)**	
Share of Risky Financial Assets	−/+	Coef.	T	Coef.	Z	Coef.	Z
Stock Market Expectation	+	0.004**	(2.18)	0.022***	(2.50)	0.020**	(2.34)
Risk Aversion (1-High)	−	0.002	(0.47)	-0.089	(-1.24)	-0.036	(-0.59)
Risk Aversion X Expectation	−	-0.033	(-1.22)	0.019	(1.27)	0.006	(0.48)
Female	−	-0.021	(-0.74)	0.037	(1.06)	0.005	(0.16)
Married	−	-0.075***	(-2.62)	-0.076**	(-2.37)	-0.093***	(-3.01)
36≤ Age ≤50	−	0.005	(0.13)	0.047	(1.07)	0.053	(1.14)
51≤ Age ≤65	−	-0.006	(-0.14)	0.017	(0.38)	0.008	(0.16)
65<Age	−	0.102*	(1.76)	0.171***	(2.86)	0.145**	(2.37)
High level education	−	0.019	(0.78)	0.014	(0.52)	0.021	(0.81)
Self-employed	+	0.329***	(8.32)	0.337***	(7.50)	0.362***	(8.10)
Retired	−	0.011	(0.26)	-0.005	(-0.12)	0.016	(0.38)
Unemployed	−	0.088*	(1.85)	0.059	(1.06)	0.100*	(1.91)
Other occupations	−	-0.016	(-0.32)	-0.003	(-0.06)	-0.011	(-0.22)
House owners	−	0.077**	(2.11)	0.078**	(2.02)	0.085**	(2.19)
Financial assets *(Q_2)*	+	-0.026	(-0.41)	-0.011	(-0.16)	0.004	(0.06)
Financial assets *(Q_3)*	+	-0.025	(-0.38)	-0.013	(-0.19)	-0.004	(-0.05)
Financial assets *(Q_4)*	+	-0.046	(-0.67)	-0.027	(-0.39)	-0.010	(-0.15)
Net worth *(Q_2)*	+	-0.143***	(-2.75)	-0.170***	(-2.95)	-0.138***	(-2.28)
Net worth *(Q_3)*	+	-0.158***	(-2.70)	-0.188***	(-2.91)	-0.172***	(-2.60)
Net worth *(Q_4)*	+	-0.171***	(-2.74)	-0.203***	(-3.03)	-0.179***	(-2.59)
Knowledge Level *(More or Less)*	+	-0.060	(-1.62)	-0.095**	(-1.99)	-0.067*	(-1.63)
Knowledge Level *(High)*	+	-0.079**	(-1.94)	-0.118**	(-2.32)	-0.086**	(-1.94)
Advice *(Media)*	+	-0.046	(-1.28)	-0.085**	(-1.93)	-0.060	(-1.48)
Advice *(Professional Advisor)*	+	-0.007	(-0.18)	-0.037	(-0.84)	-0.008	(-0.20)
Advice *(Others)*	+	-0.002	(-0.03)	-0.047	(-0.74)	-0.026	(-0.43)
Year 2005	−	-0.002	(-0.13)	0.053**	(1.99)	0.035	(1.42)
Year2006	+	0.018	(1.01)	0.027	(1.25)	0.020	(1.02)
Constant		0.566***	(7.30)	0.487***	(4.98)	0.419***	(4.31)
R-squared			0.1694		0.6061		0.6405
N of Observations			1013		1003		911
N of Individuals			530		523		485

Underidentification test: P-value of Kleibergen-Paap rk LM statistics, Chi-sq (3)	0.000	0.000
Overidentification test: P-value of Hansen J-statistic, Chi-sq (2)	0.9095	0.4461
Endogeneity test: P-value on Ex, Chi-sq (1)	0.00	0.00
Endogeneity test: P-value on Ex'RA, Chi-sq (1)	0.00	0.09
Exogneity test: P-value of C statistic on Risk Aversion, Chi-sq (1)	0.92	0.31
Exogneity test: P-value of C statistic on Future Expectations Instruments, Chi-sq (2)	0.94	0.66
Exogneity test: P-value of C statistic on Horizon Instruments Chi-sq (3)		0.37

Panel B - First-Stage Regressions of GMM estimates

We present first-stage regression results from the GMM (3) and GMM (4) models. F-statistics are cluster robust, and our standard errors are clustered by individuals and robust to heteroskedasticity. The significance level is defined by the two-tailed p-values of 1%***, 5%**, and 10%*.

First Stages	GMM (3) – First-Stages				GMM (4) – First-Stages			
	Expectation (Ex)		Interaction (Ex'RA)		Expectation (Ex)		Interaction (Ex'RA)	
	Coef.	T	Coef.	T	Coef.	T	Coef.	T
Risk Aversion (1-High)	0.237	(0.27)	7.088***	(9.24)	0.539	(0.44)	7.747***	(7.42)
Female	-1.632***	(-2.81)	-1.128***	(-2.95)	-1.721***	(-2.78)	-1.109***	(-2.74)
Married	0.089	(0.15)	0.209	(0.73)	0.176	(0.29)	0.082	(0.29)
36≤ Age ≤50	-1.344*	(-1.67)	-0.273	(-0.79)	-1.399*	(-1.63)	-0.335	(-0.89)
51≤ Age ≤65	-0.056	(-0.07)	-0.300	(-0.77)	-0.245	(-0.28)	-0.474	(-1.19)
65<Age	-1.871*	(-1.73)	-1.101*	(-1.91)	-1.657	(-1.45)	-0.967*	(-1.66)
High level education	0.149	(0.31)	-0.008	(-0.03)	-0.106	(-0.21)	-0.070	(-0.26)
Self-employed	-0.777	(-0.94)	0.191	(0.40)	-0.980	(-1.14)	0.293	(0.57)
Retired	0.632	(0.70)	0.323	(0.75)	0.341	(0.35)	0.420	(0.97)
Unemployed	1.751*	(1.72)	0.834	(1.11)	1.727	(1.62)	1.060	(1.35)
Other occupations	-0.802	(-0.63)	0.584	(1.19)	-0.955	(-0.69)	0.502	(0.97)
House owners	-0.609	(-0.78)	-0.229	(-0.61)	-1.054	(-1.29)	-0.365	(-1.01)
Financial assets *(Q_2)*	-0.624	(-0.45)	0.044	(0.08)	-1.353	(-0.87)	-0.325	(-0.54)
Financial assets *(Q_3)*	-0.808	(-0.64)	0.231	(0.37)	-1.839	(-1.30)	-0.236	(-0.35)
Financial assets *(Q_4)*	-0.895	(-0.70)	-0.161	(-0.26)	-1.885	(-1.31)	-0.689	(-1.08)
Net worth *(Q_2)*	1.726	(1.53)	0.301	(0.65)	1.860	(1.44)	0.252	(0.59)
Net worth *(Q_3)*	1.984*	(1.64)	0.520	(1.02)	2.278*	(1.69)	0.698	(1.50)
Net worth *(Q_4)*	2.091*	(1.63)	0.642	(1.11)	2.485*	(1.77)	0.805	(1.60)
Knowledge Level *(More or Less)*	1.284*	(1.76)	0.746	(1.22)	1.365*	(1.65)	0.630	(0.89)
Knowledge Level *(High)*	1.341*	(1.65)	0.767	(1.21)	1.245	(1.38)	0.624	(0.87)
Advice *(Media)*	1.850***	(2.65)	0.602	(1.45)	1.313*	(1.70)	0.465	(1.09)
Advice *(Professional Advisor)*	1.800***	(2.60)	0.489	(1.26)	1.471*	(1.91)	0.312	(0.76)
Advice *(Others)*	2.735***	(2.66)	0.206	(0.46)	2.147**	(2.15)	0.195	(0.41)
Year 2005	-2.154***	(-5.12)	-0.744***	(-2.87)	-2.277***	(-5.14)	-0.724**	(-2.52)
Year2006	-0.379	(-0.81)	-0.215	(-0.80)	-0.447	(-0.89)	-0.318	(-1.07)
Future Expectation *(Stay the same)*	-2.621***	(-4.90)	0.200**	(1.97)	-2.537***	(-4.70)	0.194**	(1.96)
Future Expectation *(Will deteriorate)*	-3.003***	(-3.25)	0.099	(0.66)	-2.713***	(-2.85)	0.064	(0.41)
Future'RA *(Stay the same)*	-0.654	(-0.61)	-3.123***	(-3.47)	-1.048	(-0.89)	-3.742***	(-3.66)
Future'RA *(Will deteriorate)*	-1.905	(-1.41)	-4.642	(-4.39)	-3.308**	(-2.30)	-5.931***	(-5.37)
Horizon *(Next year)*					0.646	(0.79)	-0.119	(-1.23)
Horizon *(Next couple of year)*					1.436**	(1.99)	-0.059	(-0.57)
Horizon *(More than five years)*					0.455	(0.59)	-0.022	(-0.18)
Horizon'RA *(Next couple of months)*					-0.424	(-0.31)	-1.623	(-1.48)
Horizon'RA *(Next couple of year)*					-0.390	(-0.30)	0.245	(0.22)
Horizon'RA *(More than five years)*					2.144*	(1.66)	1.414	(1.31)
Constant	5.441***	(3.29)	-0.966	(-1.16)	6.366***	(3.07)	-0.048	(-0.06)
F-statistics of instrument		11.74		6.28		6.53		5.54
R-squared		0.4509		0.3543		0.4632		0.3770
N of Observations		1003		1003		911		911
N of Individuals		523		523		485		485

The coefficients of stock market return expectations in the GMM (3) and (4) models are about five times greater than that in the OLS(2) model. The exogeneity tests confirm that employing IV estimates results in obtaining consistent coefficients.

We observe significant effects from the control variables which also affect investors' portfolio allocations. Investors' marital status affects their portfolio allocations significantly and negatively and this is consistent with the findings of Barber and Odean (2001). Although stock market participation is highest among individuals aged from 36 to 50 (not reported), those aged 65 and over hold the highest proportion of risky assets in their portfolios. According to Hurd (1990), this could be explained by different mortality rates between richer and poorer elderly individuals. He argues that mortality rates are associated with wealth level, and both mortality rates and wealth level are determined by lifetime health differences. Self-employed investors hold significantly more risky assets, supporting Barsky *et al.*'s (1997) finding that such individuals are more risk tolerant. Home owners hold significantly higher proportions of risky assets than do renters, who perhaps prioritise a need to save in order to purchase their houses.

Following Cocco (2004) and Cocco, Gomes and Maenhout (2005), we control for the credit constraints on individuals by considering their net worth. In contrast to our expected direction of influence, we observe that compared to those investors in the lowest net worth quartile group, those in the higher quartiles hold smaller proportions of risky assets. These results are affected by the smaller total net worth of those investors in the lowest quartile group, less than half of whom own real estate. Those investors in the higher net worth quartiles hold comparatively smaller proportions of risky assets due to the high proportion of their total assets represented by real estate. This result is also supported by the univariate test (not reported), and adding extra

variables such as the real estate investment variable does not change the signs of net worth quartiles.

Although we observe that individuals' self-evaluated knowledge levels have a positive effect on their stock market participation decisions, when we look at investors only, the effect becomes negative when explaining investors' portfolio allocations. Those who evaluate themselves as highly knowledgeable hold on average twice the total financial assets of those who assess themselves as not knowledgeable, but the proportions of risky assets held are smaller.

The validity of our instruments in GMM (3) is supported by the *F*-statistics from the first-stage regressions, these are 11.74 and 6.28 for stock market expectations and the interaction term, respectively. Hansen (1982)'s *J*-statistics also support the validity of our instruments in GMM (3), failing to reject over-identification restrictions. The Anderson canonical correlations likelihood-ratio test (Anderson, 1984) rejects under-identification restrictions. In GMM (4), the *F*-statistics from the first-stage regressions are lower (6.53 and 5.54, respectively) due to the weak explanatory power of the investment horizon instrument. Additionally, under-identification restrictions are rejected by the Anderson canonical correlations likelihood-ratio test (Anderson, 1984).

It is well known that the performance of inferential procedures based on IVs relies critically on the quality of the instruments used. As discussed by Van Rooij *et al.* (2011, 2012), however, IV estimates should be interpreted with caution, and we cannot confirm that our instruments truly determine the direction of causality. For many empirical studies, finding appropriate instruments with good quality is often not straightforward and usually there are not many choices available. Ebbes (2007) and Bound, Jaeger, and Baker (1995) argue that instruments which correlate weakly with endogenous variables create more problems, providing large inconsistencies in the IV

estimates. If there are high correlations between the instruments and the endogenous variable, the IV estimates are more consistent; however the orthogonality of the instruments is often questioned. Our instruments cannot be validated as such given the constraints and limited alternatives. The endogeneity of stock market expectations, however, should be accounted for in order to correctly determine its effect on individuals' stock market participation. We extend our models by robustness checks in order to further validate our findings.

4.5 Robustness Checks

We extend our GMM (1) and (2) models in order to assess the robustness of our findings. We fail to reject our second hypothesis that the effect of stock market expectations on stock ownership decisions depends on the level of risk aversion. It is unclear, however, as to whether this effect remains significant after including other influential variables in the models. Individuals' expectations as to their own financial situations as well as of the stock market are possibly affected by unobserved individuals' characteristics omitted from our models.

One possible control variable which may link stock market expectations to stock ownership decisions is the health status of individuals. Rosen and Wu (2004) find a negative relationship between poor health and both stock ownership and the share of financial portfolios invested in risky assets. Given the fact that individuals are unable to diversify their health risk, Christelis *et al.* (2010) emphasise that it is a particular concern for elderly individuals who are typically faced with higher health risk. We identify individuals' perceived health status, by using the following question from the DHS: *"Compared to one year ago, would you say your health is better now or worse?*".

Individuals' responses are categorised as 'better', 'about the same', or 'worse'[36]. Appendix B presents the survey questions and the mean values of each response category for the additional control variable.

We run both GMM (1) and GMM (2) models including the health control variable. In Table 15, in the interests of clarity, we report only the estimates of stock market expectations, risk aversion and their interactions, and the additional control variable.

The effects of health status are significant in determining stock ownership only at the 10% level but the sign is negative as expected. The negative interactions between stock market expectations and risk aversion remain statistically significant with the incorporation of this additional control variable. The inclusion of this variable affects the magnitude of these coefficients to only a minor extent.

We also undertake several robustness checks with regard to our model specifications. Following Kapteyn and Teppa (2011), we define investors as those who hold risky financial assets comprising mutual funds, individual company shares, options, and equities in their own business. We undertake our estimations after redefining risky financial assets as the sum of financial resources invested in individual company shares and mutual funds. Our results are unaffected by this modification. In particular, in explaining individuals' stock ownership, interactions between individuals' stock market expectations and risk aversion remain statistically significant.

Thus, we conclude that although the OLS model fails to identify these interactions, by accounting for the endogeneity inherent in individuals' stock market expectations, we observe that the interactions exist and are robust after controlling for other influences on stock ownership.

[36] Individuals' responses as to health status may change over the three year period. Those who indicate 'better' initially, mostly remain in the categories of 'better' or 'about the same'; only a small proportion of those who indicate 'about the same' in the initial year change their status over time; and those who initially indicate 'worse' remain mostly within that category or within 'about the same'.

Table 15 Robustness Checks

We extend the GMM (1) and GMM (2) models with additional control variables. In GMM (1), we include only the instrument, individuals' expectation as to their own financial situations, while in GMM (2) we also include investment horizon as an instrument in the first-stage regressions. For simplicity, we only report the second stages from the IV estimates and only those coefficients which are our concern. The dependent variable takes a value of 1 if individuals own any risky financial assets; otherwise, it takes a value of zero. Ex stands for stock market expectations, and Ex'RA stands for the interactions between stock market expectations and risk aversion. F-statistics are cluster robust, and our standard errors are clustered by individuals and robust to heteroskedasticity. The significance level is defined by the two-tailed p-values of 1%***, 5%**, and 10%*.

		GMM (1)		**GMM(2)**	
Stock Market Participation	–/+	Coef.	Z	Coef.	Z
Stock Market Expectation	+	0.053***	(4.34)	0.040***	(3.59)
Risk Aversion	–	-0.076	(-1.42)	-0.111**	(-2.37)
Risk Aversion X Expectation	–	-0.027*	(-1.85)	-0.023*	(-1.86)
Health condition now compared to last year					
About the same	–	-0.054*	(-1.87)	-0.044	(0.11)
Worse	–	-0.034	(-0.93)	-0.034	(0.33)
R-squared			0.4197		0.5149
N of Observations			2722		2511
N of Individuals			1468		1361
Underidentification test: P-value of Kleibergen-Paap rk LM statistics, Chi-sq (3)			0.000		0.000
Overidentification test: P-value of Hansen J-statistic, Chi-sq (2)			0.952		0.3479
P-value exogneity test (Ex, EX'RA)			0.00		0.00
F-statistics from first-stage regression: Ex			17.91		6.87
F-statistics from first-stage regression: Ex'RA			11.18		5.00

4.6 Summary and Conclusion

Previous studies suggest that the heterogeneous stock market expectations of individuals may provide an answer (Hurd *et al.*, 2011; Kezdi and Willis, 2009; Dominitz and Manski, 2007) to the stockholding puzzle (Haliassos and Bertaut, 1995). What truly influences individuals' heterogeneous stock market expectations, however, is hard to determine. According to Dominitz and Manski (2011), individuals develop their expectations in many different ways, and over time they are likely to apply a mixture of different approaches. Despite this, however, one of the relatively constant behavioural features of individuals, influencing not only their stock market expectations

but also their portfolio allocation decisions, is their levels of risk aversion. In order to account thoroughly for the heterogeneity of individuals' expectations and their portfolio allocation decisions, we highlight the effect of risk aversion in this chapter.

Eliciting both individuals' stock market expectations and risk aversion levels from the Dutch National Bank Household Survey (DHS) over the period 2004-2006, we find, consistent with our first hypothesis, that there are significant and negative effects from individuals' risk aversion levels which lead them to hold negative stock market expectations. With regard to our second hypothesis, we find that there are significant and negative interactions between stock market expectations and risk aversion levels in determining individuals' stock ownership decisions, in addition to the effects of these two variables singularly. This finding is robust to the inclusion of additional variables to control for individuals' health status within our models. With regard to our third hypothesis, concerning investors' portfolio allocations, stock market expectations exhibit significant and positive influences, while risk aversion and the interactions between individuals' stock market expectations and their risk aversion levels are no longer significant once they have become active market participants.

In determining the effect of individuals' stock market expectations on their portfolio allocation decisions, we take account of the endogeneity issue in respect of the expectations variable. We use instrumental variables (IV) estimations with additional instruments to account for the causal effect, as well as potential measurement errors and omitted variable bias. Thus our study contributes to the literature not only by addressing the effect of risk aversion in linking individuals' stock market expectations with their stock market participation decisions, but also by considering the endogeneity issue more rigorously than does prior work. Nevertheless, Van Rooij *et al.* (2011, 2012) suggest that identifying appropriate instruments is challenging, and we do not assert

that our instruments provide a resolution of the causality issue in respect of individuals' stock market expectations and their investment decisions. Thus, our results based on IV estimates should be interpreted with caution.

In addition to supporting the previous findings in respect of the prevalent pessimistic views of the stock market held by individuals, our work reinforces the arguments that individuals' risk aversion levels have a permanent and negative effect on their expectations of future stock market returns, thus preventing them from participating in the stock market. Although individuals' recent stock market experiences are recognised as a strong influence on the determination of short-term changes in their stock market expectations (De Bondt, 1993, 1998; Graham and Harvey, 2001), we argue that there are also persistent effects on expectations arising from heterogeneity in individual characteristics such as risk aversion.

Chapter 5 Conclusion

5.1 Summary and Discussion

Adopting a behavioural finance approach, which recognises the influence of cognitive psychology on individuals' decision-making processes under uncertainty, this thesis investigates real individual investors' portfolio allocation decisions. Individual investors are prone to judgment biases as they tend to rely on their intuitions which often reflect errors in their beliefs and preferences. Consequently, individuals experience unsatisfactory outcomes including unanticipated risks (Kahneman and Riepe, 1998; Kahneman, 2003).

Furthermore, psychologists have argued that individuals' decisions are affected by the frame of the problem and presentation of outcomes (Kahneman and Tversky, 1984; Loewenstein, 1988), as well as their personal characteristics, in contrast to expected utility theory which assumes that individuals make consistent decisions regardless of how relevant information is presented. Subsequently, by evaluating the effects of individuals' psychological biases, this thesis aims to understand why, and to what extent, individual investors depart from rational or optimal investment practices.

In particular, the thesis attempts to provide answers to two closely related enduring conundrums in the market. Firstly, the Equity Premium Puzzle of Mehra and Prescott (1985) raise a question as to why the equity premium remains so high; and secondly, the Stockholding Puzzle of Haliassos and Bertaut (1995) questions why so few individuals hold stocks despite the existence of the high equity premium. Subsequently, in Chapter Two of the thesis, an in-depth literature review of previous findings related to these two puzzles is presented and the background of psychological arguments is discussed.

Chapter Three of the thesis assesses 400 Dutch individual investors' responses to the Dutch National Bank Household Survey (DHS) and their related investment decisions over the period 1997-2010. Based on the predictions of Benartzi and Thaler (1995) regarding the effects of myopic loss aversion (MLA), this study develops two hypotheses in respect of individuals who are less affected by MLA than other investors: 1) these investors will invest more in risky financial assets, and 2) they will increase the proportion of risky financial assets in their portfolios over time. Identifying distinct effects from, first, the effect of myopia reflected in frequent evaluation and rebalancing, and, second, loss aversion, the study finds that higher levels of investors' loss aversion lead to them holding a lower proportion of their investments in risky financial assets. The strongest effect of myopia is observed when both evaluation and rebalancing frequencies are high, and with the combined effect of myopia and higher loss aversion result in a reduction over time in the proportion of risky financial assets held by investors. Less myopic individuals increase the proportion of their investments in risky financial assets held over time regardless of the level of their loss aversion.

In response to the Equity Premium Puzzle raised by Mehra and Prescott (1985), the findings of Chapter Three validate the argument of Benartzi and Thaler (1995) that the high equity premium, to which expected utility theory fails to provide an answer, can be explained by the notion of myopic loss aversion. If individual investors evaluate their portfolios frequently, responding to short-term volatility in the market, they will realise frequent losses in their mental accounts; consequently, they will demand a substantial equity premium to compensate for those risks. If they evaluate their investment performance over the long-term, however, they visualise much smaller risks relative to returns associated with stockholding; consequently, they will be ready to accept a smaller equity premium (Rabin and Thaler, 2001).

Chapter Four investigates individuals' stock market expectations, and their consequent investment decisions over the period 2004-2006, based on questions released by the DHS. In response to the stockholding puzzle of Haliassos and Bertaut (1995), the study evaluates the variations in individuals' stock market returns expectations together with the levels of their risk aversion, and considers the combined effect of these two variables and their consequent influence.

The findings of this study indicate that individuals' expectations are significantly and negatively affected by their risk aversion. Individuals' stock market participation decisions are significantly determined by the interaction between their stock market expectations, and their risk aversion. Additionally, there are independent and positive effects from stock market expectations, and independent and negative effects from the levels of risk aversion. Those who are highly risk averse will forgo a high equity premium, as their stock market return expectations are negatively influenced by their levels of risk aversion.

Once individuals hold stocks, their portfolio allocation decisions, defined in terms of the proportion of risky financial assets in their portfolios, are only affected by their stock market expectations, rather than by both their levels of risk aversion and its interaction with their expectations.

Previous literature in this area, such as Hurd *et al.* (2011) and Kézdi and Willis (2009), finds that individuals' expectations of stock market returns are much lower than historical average market returns, inhibiting their stockholdings. In this chapter, individuals' pessimistic perceptions are captured by their risk aversion levels which are fundamental to them forming their stock market returns expectations, and the systematic interaction of these two variables provides a plausible response to the stockholding puzzle.

Based on the findings, this thesis highlights the important role of psychology of perceptions, arguing that individuals make different investment decisions depending both on the manner by which they perceive the returns on their own investment portfolios and on stock market returns. Unlike rational investors described in standard economic and finance theory, real individual investors require interventions from financial advisors policy makers to moderate the distortion in their decision-making resulting from their biased risk perceptions.

5.2 Significance of Research

De Bondt (1998) suggests the particular importance of studying individual investors' financial decisions. Given the increasing longevity of people in contemporary society, partly through development of medicines and treatments, the long-term effects of individuals' financial decisions are assuming ever increasing importance, and are likely to have profound effects for their well-being in the latter stages of their lives. Increasingly, national social security systems are inadequate to cover the financial needs of the populations they are designed to serve and, individuals are expected to take increasing responsibility for their own financial arrangements. In addition, the worldwide trend, reflecting decreasing financial returns and changing demographics, in terms of pension provision is to forsake defined benefit plans in favour of defined contribution plans and this shift has exposed more individuals than ever before to stock market fluctuations. This, again, emphasises personal responsibility for, and awareness of, the consequences of individuals' financial decision-making.

Furthermore, economic and financial history has established that individual investors' financial decisions affect the markets as a whole. Investors' greed and fear were mirrored dramatically by the burst of the dot-com bubble. More recently, the

subprime mortgage crisis, and the financial crisis of 2008 and the subsequent recession to which it led, highlighted the fact that individuals are prone to judgment biases and mistakes, and this phenomenon has been observed to affect both professional and non-professional market participants.

The aim of this thesis is to deliver insights into the manner in which individuals tend to make suboptimal decisions, and seeks to draw attention to the role of institutions, policy makers, and financial advisory bodies in providing effective interventions and guidelines for individual investors in order to 'nudge' them towards making sound investments. Behavioural economists have been successful in attracting public attention with their ingenious and creative ideas. Thaler and Sunstein (2009) introduced the concept of 'nudge' as picturesque shorthand for developments which influence and guide individuals to make better choices without compromising their personal freedom.

One of the nudge ideas is 'Save More Tomorrow' which was developed by Thaler and Benartzi (2004) and which aims to increase employee saving in the US. The companies which participated in this experiment offer their employees an option to 'pre-commit' to a program which automatically increases their saving rates whenever they get a salary rise. This creative idea has increased saving rates about three times in some companies and has been promoted effectively to thousands of employers. Similarly, Thaler and Sunstein (2009) argue that individuals who face important long-term decisions, such as whether or not to join 401(K) plans in the US, tend to either procrastinate, as they find it hard to make decisions given an overload of information, or select the default option. Consequently, Thaler and Sunstein (2009) suggest that private and public institutions concerned with individuals' financial decision-making should select the default option which serves the best interests of individuals.

Similarly, Dan Ariely (2010) in his book, *Predictability Irrational: The Hidden Forces that Shape Our Decisions*, highlights that it is hard for individuals to realise self-control due to their procrastination, which displaces high-priority goals with lower priority tasks. Consequently, he suggests that mechanisms such as reward substitution, and self-control contracts could help individuals to evade their temptations, and to achieve beneficial control of their decision-making in respect of their future investment levels. More specifically, examples such as the 'Ulysses contract[37]' suggest that if individuals are tied into pre-committed investment plans or strategies, they will avoid making intuitive or impulsive decisions each time they are faced with adverse movements of the market.

Increased stockholding in many European countries is reflected by the introduction of new financial instruments, which have facilitated individuals participating in the market in indirect forms such as pension funds (Guiso, Haliassos, and Jappelli, 2003). Appropriate investment options should be recommended to improve individuals' wealth management by taking account of the characteristics of each individual, and acknowledging their personal circumstances. As discussed by Van Rooij, Lusardi, and Alessie (2011, 2012), improving individuals' financial literacy through providing individuals with accessible financial information and education, is one of the viable initiatives that academics and advisory bodies can undertake.

[37] The idea derives from the story of Ulysses, in Homer's Odyssey, on his journey back from the Trojan wars. Ulysses and his crews were passing by the Sirenusian islands, the home of the Sirens. Ulysses wanted to hear the Sirens' song and survive; thus he asked his crews to put beeswax in their ears and tie him to the mast. He instructed his crews in all circumstances to ignore his request to be set free, so he could not jump into the sea to reach the irresistibly seductive Sirens. As he wished, Ulysses became the first man to survive after hearing the Sirens' song.

5.3 Limitations and Suggestions for Future research

According to the Dutch National Bank Report in March 2003, the Netherlands was listed as the eighth largest country in the world in terms of cross-border portfolio holdings which amounted to 5% (€731 billion) at 31 Dec 2004, and their value increased to €862 billion in the course of 2005, which indicates the economic importance of the Netherlands. Significant growth in the number of Dutch households entering and exiting mutual funds, due to comparatively lower transaction costs than those for individual stocks, is also observed by Alessie, Hochguertel, and van Soest (2004). Studying the financial decisions of Dutch individual investors was made possible by the public availability of the Dutch National Bank Household Survey (DHS). The DHS, as a longitudinal study, provides extensive information on the demographical and psychological characteristics of individuals, and detailed information on asset classes in individuals' portfolios. Hurd *et al*. (2011) emphasise the advantage of employing this survey in research studies in that most members of the CentERdata panel are experienced survey respondents, and it is believed, therefore, that they provide meaningful answers.

This thesis is, however, subject to limitations with regard to the availability of data. Firstly, the composition of direct investments in company stocks and mutual funds held by individuals is not distinguished by the DHS. Such information would allow studies to investigate individuals' buying and selling decisions in more depth, and identify the precise levels of risk associated with individual portfolios. Secondly, the information on individuals' pension wealth is not provided reliably. Given the mandatory pension entitlements of the Dutch households, reported financial assets from the DHS which are held in the form of defined benefit and contribution pensions, and other life insurances, are insufficiently distinguished. Thirdly, the DHS provides no

information on the business assets and debts held by the self-employed. Thus, the aggregate savings and deposit balance of the self-employed fails to exclude assets held for business purposes. Alessie, Hochguertel, and van Soest (2000) argue that this misinformation results in an over-statement of the wealth of the self-employed as compared to their actual position in the wealth distribution.

With regard to the first study in Chapter Three, investors' responses for both evaluation and rebalancing frequencies, which are used as measures for the effect of myopia, and reference points and framing patterns, are observed only once; in the year 2003. If the data were available over the period 1997-2010, the findings of this study would have been enhanced in terms of accounting for time-specific effects. It is possible that investors learn from the market, and adopt different attitudes towards their investments over time; thus the treatment of those variables as time-invariant could be regarded as a limitation of the study. Also, the questions used to estimate individuals' loss aversion coefficients, are based on their responses during the period 1997-2002, thus incorporating the dataset for the myopia questions of 2003 results in the sample size of the study reducing dramatically. To estimate investors' portfolio rebalancing frequency, we asked how often they change their stock portfolios without the need for cash. This question is, however, developed without due consideration as to possible confusion with the fairly common 'regular' monthly investment in either equities or mutual funds. We acknowledge that there is room for ambiguity in responses to this question.

With regard to the second study in Chapter Four, the question which measures individuals' stock market expectations from the DHS is only available for the period 2004 to 2006. If, however, a more extensive dataset was available with higher-frequency observations, i.e. monthly or quarterly, the study would have been able to

compare individual investors' stock market expectations with the short-term volatility of the market. Investors update their beliefs and portfolios continuously through a process of evaluating their own expectations and investment returns, in the context of realised market returns. Thus a more extensive data set would have allowed investigation of the question as to whether changes in individuals' expectations lead to changes in asset allocation. Future studies in this area could be enhanced by the availability of a long-term dataset with higher frequency. For this empirical study, we adopt the IV estimates to control for endogenous variables in the models. However, due to the constraints and limited alternatives available, we were unable to employ appropriate instruments of desirable quality.

More radically, future research could employ interviews and in-depth observation to fully understand the motives of individuals making financial decisions. To understand what truly determines individual investors' perceptions of, and motives for, their own financial decisions, behavioural finance researchers who incorporate personality studies, such as Statman and Wood (2004) and Pan and Statman (2010; 2012) believe that understanding individuals' personalities will improve understanding of their decision-making. Such work emphasises that it is important for financial advisors to consider not only the wealth, but also the well-being of investors. Understanding investors' temperaments enables advisors to communicate better and design portfolios with a balance of potential and protection which reflect investors' aspirations.

Similarly, in addition to the introduction of cognitive and social psychology to the fields of economics and finance, the incorporation of neuroscientific methods in experimental studies has led to the development of *neuroeconomics,* adding another layer to behavioural studies. Studies in this field argue that opening up the ultimate

‘black box’, which interconnects individuals’ brain mechanisms with their motives for behaviours, leads to a significant improvement in understanding human decision-making (Camerer, Loewenstein, and Prelec, 2005).

Previous behavioural finance studies concentrate heavily on datasets for US households; however, there is a growing interest in comparing households’ stockholding decisions across continents. Following the studies of Guiso, Haliassos, and Jappelli (2002; 2003) which compare household finances mainly in European countries, Christelis, Georgarakos, and Haliassos (2011, 2012) include many different countries in their analysis, and expand the research domain to take account of cultural and institutional effects, opening a new door to a worldwide and comprehensive review of household finance.

5.4 Concluding Remarks

One of the renowned behavioural proponents, Statman (2005), argues that individual investors were never 'rational' as defined by standard economic and finance theories, but rather that they were always 'normal' even before the introduction of these theories. Normal investors are often affected by their cognitive biases and emotional swings, exhibiting normal 'human nature'. Similarly, Statman (1999) posits that psychological considerations have always been an element in any financial transaction, as behavioural finance has (re)discovered. Human decision-making processes are complex and determined by various reasons depending on each individual circumstance.

When Markowitz (1952a) wrote the seminal paper on mean-variance theory which governs modern portfolio management, he also developed a framework for a utility function which shifts with the level of 'customary wealth' (Markowitz, 1952b). Distinguished from other works by Markowitz, his paper (1952b) on 'The Utility of Wealth' in the *Journal of Political Economy*, further develops the notion of Friedman and Savage (1948). Describing individuals' utility functions when buying both lottery tickets and insurance, Markowitz, (1952b) contributes to the foundations of *Prospect Theory* (Kahneman and Tversky, 1979) and *Behavioral Portfolio Theory* (Shefrin and Statman, 2000).

Behavioural finance studies have recognised the endless anomalies and social, cognitive, and emotional factors which affect stock prices, corporate finance, and house prices, as well as individual investors' financial decisions. Such behavioural approaches which have prospect theory at their heart (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992), embrace the notion of bounded rationality (Simon, 1982). Individuals, who are prone to their judgment biases, are more realistically described in terms of their decision-making under uncertainty by these approaches.

The Behavioural Portfolio Theory (BPT) of Shefrin and Statman (2000), developed as an alternative to the Capital Asset Pricing Model (Sharpe, 1964; Lintner, 1965), also makes a contribution to the intellectual tool-kit of behavioural finance. The two empirical studies of this thesis highlight and reinforce previous work finding that individuals' departures from optimal or rational investment decisions are due to their behavioural or psychological propensities and do not always lead to decisions in their best interests. Real world individuals are not Mill's *homo economicus,* lacking as they do unconditional rationality, while failing to maximise their utility, as a result of their often irrational preferences and constraints. After all, it seems as though it is harder for economists to sell their 'ex-parrot utility theory' despite its beautiful plumage[38].

[38] This expression is from the classic comedy sketch of the Monty Python's Flying Circus. One of the episodes includes a story of a customer who asks a pet shop owner for a refund for the parrot, 'Norwegian Blue', which was already dead when he bought it, and of the owner who insists that the parrot is still alive. The customer even takes the parrot out from the cage and beats it on the counter, to prove the parrot is dead. The shopkeeper, ignorantly points to the parrot and says "beautiful plumage", and the angry customer responds that "the plumage don't enter into it." After employing a list of different ways to say that the parrot is dead, the final statement he makes is, "This is an ex-parrot." This story is also adapted by Rabin and Thaler (2001).

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Appendix A: Variable Definitions

Dependent variables:

SRFA: The share of the total financial assets invested in risky financial assets.
Δ*SRFA:* The change in SRFA.
D.SRFA: The net change in SRFA corrected for the impact of the market return.

Explanatory variables*:*

Level of Myopia =
HEHR: high evaluation and high rebalancing frequencies; omitted as a reference category
HELR: high evaluation and low rebalancing frequencies = 1, if yes; 0, if no.
LEHR: low evaluation and high rebalancing frequencies = 1, if yes; 0, if no.
LELR: low evaluation and low rebalancing frequencies = 1, if yes; 0, if no.

Loss Aversion = coefficient of loss aversion estimated using the procedure described in Dimmock and Kouwenberg (2010).
Discount Rate = coefficient of discount rate estimated using the procedure described in Dimmock and Kouwenberg (2010).

Level of Risk Aversion = 1, if levels are high; 0 if levels are low.
Level of Time preference = 1, for long-term; 0 if short-term.

Reference Points = Looking at initial investment price = 1, if yes; 0, if no.
Looking at return on savings account = 1, if yes; 0, if no.
Looking at market return (Omitted as a reference category)
Looking at other reference points = 1, if yes; 0, if no.

Framing Patterns = Looking at individual shares only = 1, if yes; 0, if no.
Looking at both individual shares and whole portfolio = 1, if yes; 0, if no.
Looking at whole portfolio (Omitted as a reference category)

Gender = 1, if male; 0 if female.
Age = Actual age
Marriage Status = 1, if married; 0 if single.
Education = 1, if university or college graduate; 0 if below.
Occupation = Regular employment; omitted as a reference category
Self-employed = 1, if yes; 0, if no.
Retired = 1, if yes; 0, if no.
Others = 1, if yes; 0, if no.

Financial Assets = Total Financial Assets in €/100,000
Debt Ratio = Total Debts/Total Assets

Appendix B: Survey Questions Descriptions of Behavioural Factors

Appendix B presents the DHS survey questions and mean values over 2004-2006 are categorised as dummy variables which take 1 if the following definitions apply to individuals. These questions are included in our study as control variables, and instruments in the IV estimates.

Survey Questions	Definition	2004	2005	2006	Total	*N*
Control Variables						
Financial Knowledge Level						
How knowledgeable do you consider yourself with respect to financial matters?	Not knowledgeable	0.140	0.142	0.131	0.138	2956
	More or less	0.584	0.591	0.590	0.588	
	Knowledgeable	0.276	0.267	0.280	0.274	
Source of Financial Advice						
What is your most important source of advice when you have to make important financial decisions for the household?	Parents, Friends, etc.	0.190	0.202	0.212	0.201	2956
	The Media	0.459	0.454	0.467	0.459	
	Professional Advisers	0.282	0.276	0.250	0.271	
	Others	0.069	0.068	0.072	0.069	
Instruments						
Expected Financial Situation						
Do you expect your financial situation to improve or deteriorate in the coming year?	Improve	0.234	0.205	0.238	0.225	2939
	Stay the same	0.559	0.528	0.519	0.537	
	Deteriorate	0.207	0.267	0.243	0.239	
Investment Horizon						
People use different time-horizons when they decide about what part of the income to spend, and what part to save. Which of the time-horizons mentioned below is in your household MOST important with regard to planning expenditures and savings? Which of the time-horizons mentioned below is in your household MOST important with	Next couple of months	0.299	0.359	0.314	0.324	2655
	Next year	0.235	0.194	0.221	0.217	
	Next couple of years	0.316	0.292	0.321	0.309	
	More than five years	0.150	0.155	0.144	0.150	
Additional Control Variable						
Expected Health Condition						
Compared to one year ago, would you say your health is better now or worse?	Better	0.127	0.113	0.108	0.117	2737
	About the same	0.757	0.741	0.753	0.750	
	Worse	0.116	0.146	0.139	0.133	