ASIC
Australian Securities & Investments Commission

REPORT 427

Investing in hybrid securities: Explanations based on behavioural economics

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About this report

This report was commissioned by ASIC and produced by Queensland Behavioural Economics Group (QuBE). It sets out the results of research into how behavioural biases may influence preferences towards hybrid securities over the less complex financial products of bonds and shares.

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Investing in hybrid securities: Explanations based on behavioural economics

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Executive summary

This report provides preliminary insight into the behavioural biases and risk attitudes that influence investment in hybrid securities. The findings are based on a pilot study that was commissioned by ASIC due to its concern that some retail investors may struggle to understand the complexity of hybrid securities and the risks they pose.

A key insight from behavioural economic research is that decisions, including investment decisions, are influenced heavily by a range of cognitive biases rather than solely rational consideration of all options. It follows that regulation aiming to improve citizens' welfare needs to take into account these biases.

The pilot study's objective was to identify the behavioural biases that impact allocation to hybrid securities within an overall investment portfolio and also assess how the perceived risk of hybrid securities compares with shares and bonds. This can inform conversations with industry, assist in the development of regulatory interventions, and contribute to improvements in ASIC's programs to advise and educate investors to make more informed decisions (such as via the MoneySmart programs).

Research approach

The research approach used techniques developed in behavioural economics, which places participants in a simulated environment in an experimental laboratory. This allows researchers full control over the factors affecting decision makers in a given situation. The laboratory experiment is usually a preliminary stage to a field experiment.

Behavioural economic techniques are increasingly used by regulatory and policy bodies, such as the Behavioural Insights Team which was founded in the Prime Minister's Cabinet Office in the United Kingdom.

The advantage of laboratory experiments is that, with all things being equal, they provide findings of individual economic agents, which are difficult to obtain using conventional econometric techniques.[1] Empirical data always include a large variety of environmental factors and a disentanglement of those is difficult if not impossible. In a laboratory experiment, these factors can be controlled allowing research to identify causal relationships.[2]

An underlying assumption is that the results generated in the artificial environment of laboratory experiments can be generalised. That is, they can be considered valid in the broader environment. Many field experiments have confirmed laboratory results.[3] In addition, laboratory experiments provide a cheap and quick method to test hypotheses.

[1] S D Levitt & J A List, 'What do laboratory experiments measuring social preferences reveal about the real world?' *Journal of Economic Perspectives*, 2007, pp. 153–174.
[2] G Charness & P Kuhn, 'Lab labor: What can labor economists learn from the lab?' *Handbook of Labor Economics*, 2011, pp. 229–330.
[3] Charness & Kuhn

In this pilot study participants were first tested to reveal their behavioural biases and risk attitudes and then participated in an investment game in which they needed to allocate a portfolio across bonds, hybrid securities and shares. The games were incentivised as participants were able to keep the 'returns' on their 'portfolio'. A sample of university students participated in 11 sessions run in May 2014 with each session comprising up to 20 subjects.

Findings

The present study provides insights into which biases are likely to be relevant for investors' decisions to invest in hybrid securities. This is followed by findings on participant's perceptions of the risk of different investment types.

Illusion of control

Investors, when subject to illusion of control bias, can feel they can exert control over their environment and influence the outcomes.

There was a highly significant relationship between *illusion of control* bias and allocation to hybrid securities. Other variables remaining constant, allocation to hybrids increased by nearly 14% for participants who demonstrated the *illusion of control* bias. *Illusion of control* bias describes the tendency of individuals to believe that they can control or at least influence the outcome of an uncertain event when actually they cannot.

Presence of illusion of control implies that investors may think that they will have the ability to control risks involved in hybrid securities, for example by withdrawing 'in time' from an investment.

Overconfidence

Investors, when subject to overconfidence, may have a misguided sense of their own ability to withdraw from an investment early and consequently be protected from risk.

Allocation to hybrids showed a positive relationship with *overconfidence* bias in participants. Although, compared to *illusion of control*, the statistical significance for these biases were weaker, they were still significant in economic terms. The average allocation to hybrids was higher by more than 10% for participants with *overconfidence* bias. *Overconfidence* relates to unwarranted belief in one's cognitive abilities, intuition, and judgement.

Overconfidence, which is positively related to illusion of control, could lead to portfolio under-diversification i.e. holding concentrated positions in a few hybrid securities. Overconfidence may tend to make investors underestimate downside risk and perceive hybrids to be safer investments than they actually are.

Framing bias

Investors susceptible to framing bias make decisions that are influenced by the formulation of the choice (i.e. how it is presented).

Allocation to hybrids showed a weak positive relationship with *framing* bias in participants. The average allocation to hybrids was higher by more than 10% for participants with *framing* bias. *Framing bias* describes the tendency of human beings to respond to the same situations differently based on the context in which a choice is presented.

The framing effect is likely to be more pronounced for hybrids as many of the risks are not immediately apparent, rendering the risk-return trade-off more appealing than shares and bonds.

Ambiguity aversion

Ambiguity aversion bias leads to a preference of known risks over unknown risks.

Ambiguity aversion bias had a strong positive relationship with allocation to shares but had a weak negative relationship with allocation to hybrids. Other factors remaining equal, the presence of *ambiguity aversion* in participants resulted in nearly 11% higher allocation to shares.

Susceptibility to ambiguity could result in investors holding a smaller proportion of hybrid investments. As a result, it could highlight the risky nature of hybrid securities.

Branding

Cognitive substitution describes the behaviour of decision makers to unconsciously replace hard questions, i.e. ‘how risky is a hybrid security’, by easier ones, i.e. ‘do I know the company (brand) issuing a hybrid security?’. Branding can result in a greater proportion of portfolios allocated to known brands of issuers of financial products.

The recognisability of the brand name of the issuer of a hybrid security in this experimental study did not influence investment choice. In fact, participants allocated a smaller share (5%) of their portfolio to known Australian brands than unknown Norwegian brands. The experiment used well known Australian brands and their likely to be unknown, but real, Norwegian counterparts.

The observation in the experiment that the familiarity of the brand did not affect investment in hybrids may indicate that where information is provided in a succinct and standardised manner the effect of a brand name may be negligible. While this remains untested it provides an option for exploration in future experiments.

Risk attitudes

Participants were asked a range of risk attitude questions about the investment options according to five broad risk perception factors. The questions were based on knowledge that risks in different investment options can be perceived in different ways.

For example risk may result from a lack of trust, the way information is presented, or from an underlying volatility of returns.

Hybrids were seen to be riskier than shares and bonds on two counts: distrust of issuers/products and poor knowledge of the product. However, acknowledging the difficulty in understanding hybrid securities did not deter participants from buying them. Possibly due to framing bias, participants focused on certain obvious features of hybrid securities and ignored important descriptive information.

The regulatory issue

Hybrid securities are complex financial products that often combine the features of debt and equity securities, the riskiness of which may not be readily understood by some retail investors.

As a result, ASIC is concerned that such investors may underestimate the risk associated with investing in hybrid securities and may be attracted to these securities based on the perception that they offer secure steady 'bond like' returns.

A reasonable understanding of the behavioural biases that influence investor decision-making, specifically in relation to investing in hybrid securities, will assist ASIC to effectively communicate risk to the public and inform conversations with industry.

This study, commissioned by ASIC, models the effect of cognitive and emotional biases on investors' choice of hybrid securities relative to other financial securities (bonds and shares) if they are not fully rational and/or poorly informed. Further, the study also explores how different types of risk perception are associated with investors' choice of hybrids compared with other type of securities.

This pilot study's objective was to identify the behavioural biases that impact allocation to hybrid securities within an overall portfolio and assess how perceived risk of hybrid securities compared with shares and bonds.

Research methodology

A multistage laboratory experiment was developed to study the relationship between the behavioural biases and the risk perception of hybrid securities. Participants were provided with stylised investment choices (shares, government bonds, and hybrid securities) and asked to allocate their experimental money to each. At the end of the experiment they were paid an amount based on the simulated outcomes of their investments.

The participants first responded to a range of questions to identify selected behavioural biases that are considered to be relevant to complex investment choices such as hybrids. Based on responses, we investigated the relationship between the biases and the investment choices made by the participants.

Behavioural biases

A series of questions were asked of experiment participants in order to identify the cognitive (and emotional) biases associated with investing in complex financial products like hybrids. Diagnostic tests were employed to look for the existence, and extent, of biases within the experimental sample.

The questions are well known in behavioural economics and were developed by Pompian[4] for testing the individual biases in the context of investment decision-making. To minimise participant fatigue, we limited the number of questions to test a specific bias to three or less. The questions focused on hypothetical situations and asked the participant what choice they would make in the circumstance or what they believed an answer to be.

The list below presents the biases tested in the experiment. The selection of these potential candidates was informed by behavioural finance literature.

- **Availability bias**: Estimation of probability of an outcome based on how prevalent that outcome appears in their lives.
- **Representativeness/familiarity bias**: Estimation of probability of an outcome based on pre-existing ideas that are statistically invalid.
- **Framing bias**: Tendency to respond to the same situations differently based on the context in which a choice is presented.
- **Recency bias**: Predisposition to emphasise recent events and observations than those that occurred in the distant past.
- **Overconfidence**: Unwarranted belief in one's cognitive abilities, intuition, and judgement.

[4] M Pompian, *Behavioral Finance and Wealth Management: How To Build Optimal Portfolios that Account for Investor Biases*, John Wiley & Sons, 2011.

- **Illusion of control**: Tendency to believe that one can control or least influence outcome of an uncertain event when actually they cannot.
- **Competence bias**: Tendency to rely more on personal judgements in predicting outcomes of uncertain events based on perception of competence
- **Ambiguity aversion**: Tendency to accept gambles with known probability of outcomes relative to ambiguous choices where probability of outcomes are unknown.
- **Mental accounting**: Tendency to evaluate economic outcomes by grouping assets into a number of non-interchangeable mental accounts.

The participants also provided responses to a set of questions which explored the relationship between key risk perception factors identified in the literature and the investment choices offered.

The risk perception factors examined were related to:

- **Distrust of product/producer**: Level of public distrust of issuer of securities.
- **Adverse consequence**: Seriousness (severity) of bad outcomes.
- **Volatility of returns**: Dislike of uncertainty of returns.
- **Poor knowledge or information**: Lack of understanding about quality and performance of financial products.
- **Regulatory failure**: Failure of regulations to protect investors.

Investment choices

A central part of the experiment was a stylised choice between different investment options. Participants were asked to invest 100 units between three investment options. Experiment participants were given the following instructions:

'On the following screens you will make six decisions on how to invest a fixed amount of money – lab $10,000 – into three different investment options for 10 years. The payoff you get from the three options will depend on a number of conditions. We want you to consider each option carefully and then to decide how to split your investment.

In the experiment you will be paid based on the outcome of your investment. The outcome of the investment is tied to a simulation of the future stock prices of two companies. You will be paid such that lab$ 900 equate to AUS$ 1. Only one of the six investment choices will be randomly selected and paid out in the end.'

This experiment was repeated 6 times by varying at least one investment options. There were 5 different investment options in total used for the experiments. Appendix A presents an overview of the different options used in the experiments.

A number of experiment parameters were put in place to compare behaviour resulting from biases with that which would normally be predicted by traditional economic theory. In each of the 6 experiments, the government bond option was provided as a default low risk option and 5 out of the 6 choices also offered company shares. We also altered the expected interest rate/dividend between three options: 3.75%, 4.75%, and 5.75% per annum.

Existing companies were chosen as a baseline for the simulation of the outcome. The companies were chosen from the top stock indexes of Australia and Norway to test for bias towards brand names. Participants were expected to be familiar with the Australian companies and unfamiliar with the Norwegian companies. This was intended to test for home bias/brand effects. We also used one bank and one non-bank entity in our design as banks commonly issue hybrid investments.

Findings

Behavioural bias and investment choice

For every individual bias, the tests allowed us to split the participants into two groups – those with and without the bias. We then examined differences in allocations by security type between the two groups for every bias. The participants responded strongly to changes in expected return.

There was very significant difference in allocation between participants with *illusion of control* bias and those without it in their selection of hybrid securities. There was also significant difference in allocations to hybrid securities for participants with or without *framing*, *overconfidence*, and *competence* bias. Participants demonstrating these biases made higher allocation to hybrids.

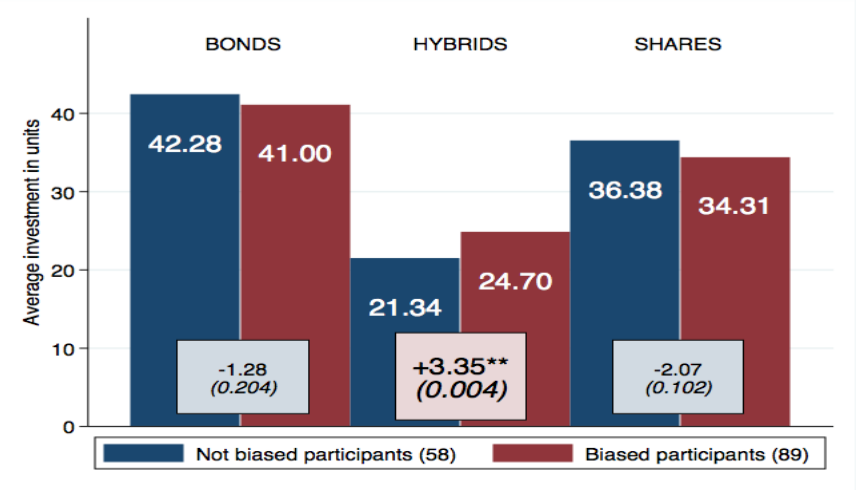
For allocation to other types of securities, the average allocation to shares was higher for participants with *ambiguity aversion* bias and lower for participants with *framing* bias. Interestingly, the average allocation to bonds was not significantly different between participants with or without any of the biases examined in the study.

Illusion of control

Investors, when subject to illusion of control bias, can feel they can exert control over their environment and influence the outcomes.

There was a highly significant relationship between *illusion of control* bias and allocation to hybrid securities. Other variables remaining constant, allocation to hybrids increased by nearly 14% for participants who demonstrated the *illusion of control* bias.

Figure 1: Allocation differences for illusion of control



Note: ***, **, * indicate significance at 10%, 5% and 1% level.

In our experiments, in choosing between two risky prospects (hybrids and shares), participants showing *illusion of control* felt they are more in control of investment outcomes of hybrids than shares. This may be due to their viewing the returns from hybrids as relatively stable (linked to bank bill rates) compared to shares.

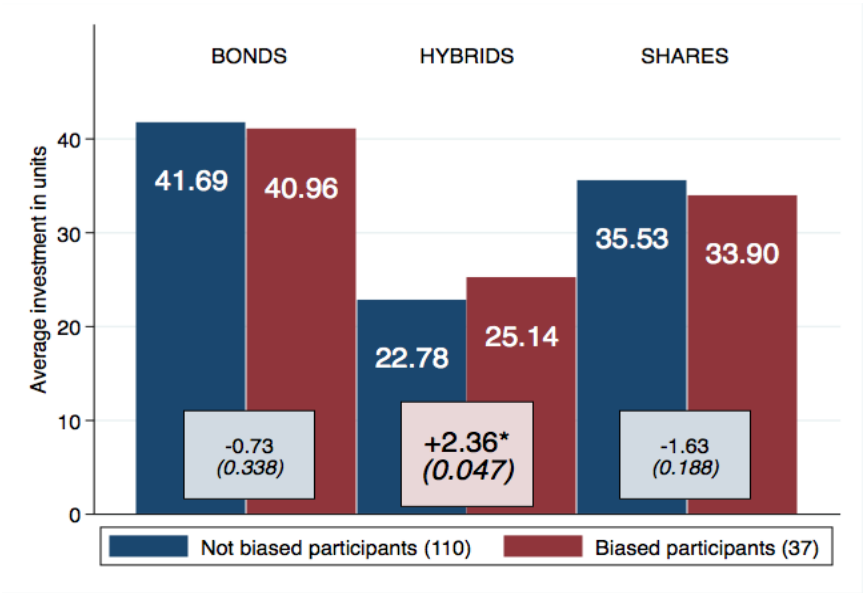
Whilst payments of hybrids could be affected by adverse events, participants with bias may have underweighted the probability such adverse events as they felt 'illusory' control over outcomes. Since, unlike shares, hybrids can suspend or defer payments only under specific conditions (which can be often very restrictive) investors may feel more in control over outcomes of their hybrid investments than those of their share investments.

Overconfidence

> *Investors, when subject to overconfidence, may have a misguided sense of their own ability to withdraw from an investment early and consequently be protected from risk.*

Allocation to hybrids showed a positive relationship with *overconfidence* bias in participants. Although, compared to *illusion of control*, the statistical significance for these biases were weaker, they were still significant in economic terms. The average allocation to hybrids was higher by more than 10% for participants with *overconfidence* bias.

Figure 2: Allocation differences for overconfidence bias



Note: ***, **, * indicate significance at 10%, 5% and 1% level.

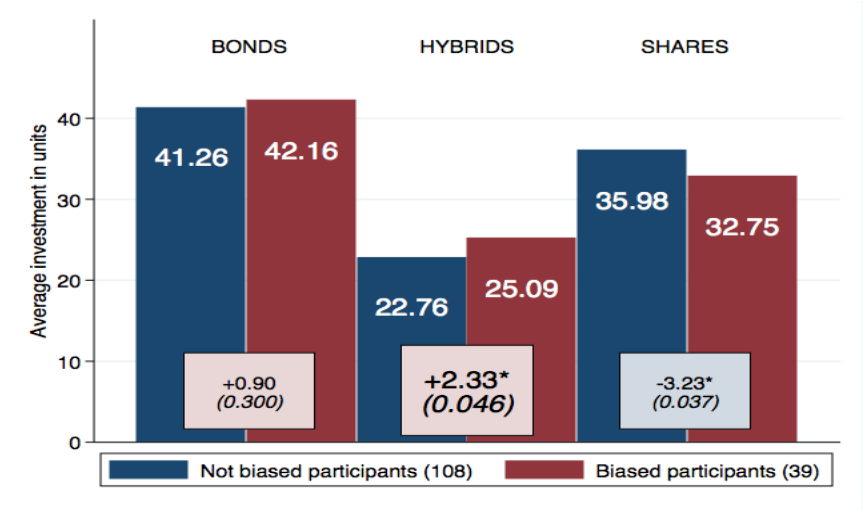
It is possible that participants demonstrating this bias may feel more overconfident when investing in hybrids than in shares if they consider that sources of risk for the latter are myriad compared to the former. It may also suggest that participants see a narrower range of risk events for hybrids which may elevate their *overconfidence*; hence it is not possible to determine which causes the other.

Framing

Investors susceptible to framing bias make decisions that are influenced by the formulation of the choice (i.e. how it is presented).

Allocation to hybrids showed a weak positive relationship with *framing* bias in participants. This may result in them focussing on a few specific aspects of the choice that are more obvious and ignore important latent information. The average allocation to hybrids was higher by more than 10% for participants with *framing* and *overconfidence* bias.

Figure 3: Allocation differences for framing bias



Note: ***, **, * indicate significance at 10%, 5% and 1% level.

The framing effect is likely to be more pronounced for hybrids as many of the risks are not immediately apparent, rendering the risk-return trade-off more appealing than shares and bonds.

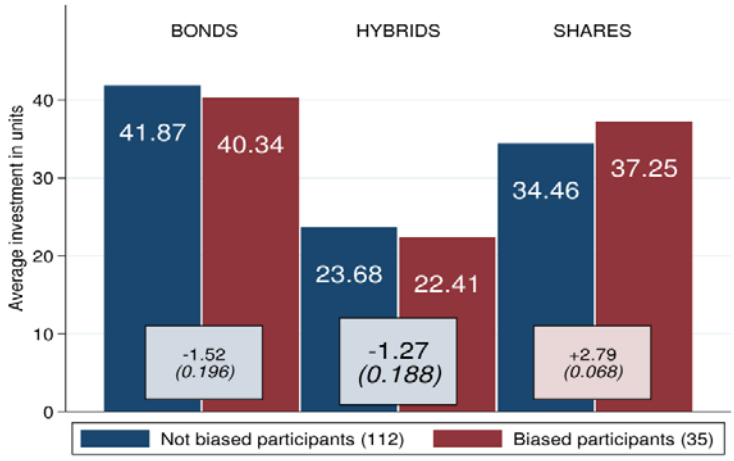
Ambiguity aversion

Ambiguity aversion bias leads to a preference of known risks over unknown risks.

Ambiguity aversion bias had a strong positive relationship with allocation to shares but had a weak negative relationship with allocation to hybrids. Other factors remaining equal, the presence of *ambiguity aversion* in participants resulted in nearly 11% higher allocation to shares.

Whilst shares may be considered as riskier than the other options by the participants, they are arguably less complex than hybrids. It is conceivable that ambiguity averse participants prefer 'higher yet familiar' risk of investing in shares to 'lower but less understood' risk of investing in hybrids.

Figure 4: Allocation differences for ambiguity aversion

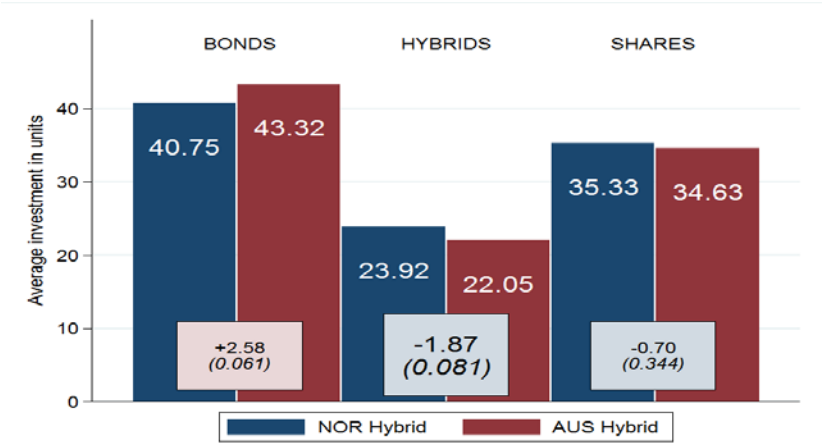


Branding and cognitive substitution

Cognitive substitution describes the behaviour of decision makers to unconsciously replace hard questions, i.e. 'how risky is a hybrid security', by easier ones, i.e. 'do I know the company (brand) issuing a hybrid security?'. Branding can result in a greater proportion of portfolios allocated to known brands of issuers of financial products.

The 'known brand' did not increase investment in hybrids. If at all, the evidence points, albeit only marginally significant, in the opposite direction: When Norwegian hybrids were an option, the share invested in hybrids was higher.

Figure 5: Allocation differences and Australian brands

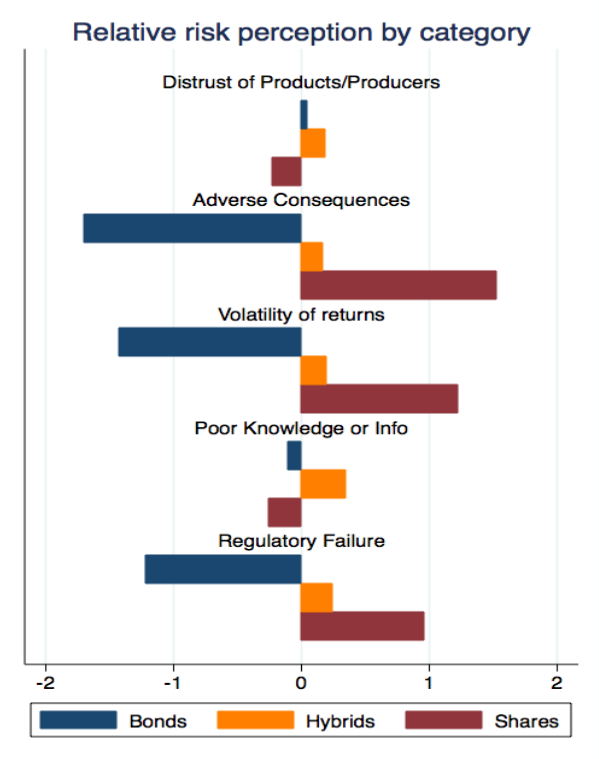


This may indicate that the brand of an issuer of a hybrid security may not affect the investment decision as much as one may expect. However, the experimental design was such that the relevant aspects of any investment option could be summarised in a table (see Appendix A) and, while this information is certainly not easy to comprehend, it is less complex than understanding a prospectus of a hybrid security.

Risk perception and investment choice

Risks in different investment options can be perceived in different ways. For example risk may result from a lack of trust or information or from an underlying volatility of returns. Participants in our experiment were asked a range of risk attitude questions to score the offered investment options according to five broad risk perception factors. The results are graphically presented in Figure 6

Figure 6: Risk perception factors



Bonds were correctly perceived as least risky in terms of three risk factors*: adverse consequence, volatility of returns,* and *regulatory failure*. For the other two factors – *distrust of products/producers* and *poor knowledge*, they ranked between hybrids and shares, which indicated that participants understood that a lack of information or a non-trustworthy issuer does not reduce these components of risk.

Shares were rated as having lower risk than both hybrids and bonds in terms of *distrust of products/producers*, *poor knowledge*. This may indicate that shares are usually perceived by participants as well defined products, that is, a product that they understand.

The perceived risk of hybrids were the highest in terms of *distrust of products/producers* and *poor knowledge*. These results provide important insights about investor's risk perception. The reputation of the issuer may seem to count more in assessment of risk for hybrids than for shares. *Poor knowledge* is seen more of a risk for hybrids than for bonds and shares. Hybrids were also seen to have only moderate risk of suffering from

adverse consequences, indicating that participants did not see this aspect of risk in the experimental hybrid securities.

With respect to the decision to invest in hybrids, it is interesting to note that only *distrust of products/producers* had an effect. Increase in distrust resulted in decrease in allocation to hybrids. Interestingly, no other perceived risk factor had any significant impact on allocations; this includes *poor knowledge* having no impact on the investment decision even though it was perceived as the biggest risk factor for hybrids.

More detailed discussion of the results is provided in Appendix D.

APPENDIX A: Features of investment options in experiments

Investment Type:	Government Bond	Subordinate Note (Bank)	Subordinate Note (Non-Bank)	Capital Note	Shares
Cost per unit	$100	$100	$100	$100	$100
Term:					
Maturity	2024	2024	2024	No Maturity (To be converted into shares in 2023 or before).	No Maturity
Early redemption by Issuer (before maturity)		2019 (at the discretion of issuer)	2019 (at the discretion of issuer)	2019 (at the discretion of issuer)	
Maturity (or Redemption) Value	Face Value of the Bond $100	Face Value of Note $100	Face Value of Note $100	Face Value of Note $100	N.A. (will be sold at the current stock price in 2024).
Maturity Payment Condition		Payment will not be made if 'Solvency' condition is not met.	Payment will not be made if 'Solvency' condition is not met.	The Scheduled Conversion date is in 2024. Holders will receive Shares worth $101 per Note (based on the initial Face Value of lab$100, with the benefit of a 1% discount).	
Interest/Dividend:					
Rate of Interest/Dividend Payment	Fixed Rate	Floating rate (Bank Bill Rate + Premium)	Floating rate (Bank Bill Rate + Premium)	Floating rate (Bank Bill Rate +Premium)	Can be variable (at the discretion of the issuer).
Interest/Dividend Payment Frequency	Yearly	Yearly	Yearly	Yearly	Yearly
Condition of Interest/Dividend Payment		Payments can be suspended only if 'Solvency' condition is not met.	Payments can be suspended under certain conditions.	Payments can be suspended at the discretion of the company.	At the discretion of the company.
Liquidity					
Transferrable/Traded in the Market	Could be sold before maturity at prevailing market price but limited trading in the market compared to shares.	Could be sold before maturity at prevailing market price but extremely little and infrequent trade in the market.	Could be sold before maturity at prevailing market price but extremely little and infrequent trade in the market.	Could be sold before maturity at prevailing market price but extremely little and infrequent trade in the market.	High trading volume in the market. Could be sold any time at the prevailing market price.
In the event of bankruptcy/liquidation					
When/how much gets paid	N/A (bankruptcy liquidation is not possible for this investment).	Will be paid only after the claims of all creditors (including depositors and senior debt holders) have been settled but before shareholders	Will be paid only after the claims of all creditors (including depositors and senior debt holders) have been settled but before shareholders	Will be paid only after the claims of all creditors (including depositors and senior debt holders) have been settled but before shareholders	Residual amount will be paid only after the claims of all creditors (including depositors, senior and sub-ordinated debt holders) have been settled

APPENDIX B: Tests for biases

Testing for biases

A brief description of the individual biases and the questions used to determine their existence in participants is provided below.

Availability bias

The availability rule of thumb underlies judgments about the likelihood or frequency of an occurrence based on readily available information but is not necessarily based on complete, objective, or factual information. In the question below, subjects are considered to have the bias if they guess that 'R' is more frequent as the first letter in English words because they can more quickly think of more of these words (while it actually occurs more often in third position).

The frequency of appearance of letters in the English language was studied. A typical text was selected, and the relative frequency with which various letters of the alphabet appeared in the first and third positions in words was recorded. Words of less than three letters were excluded from the count.

> Consider the letter **R**. Please judge whether letter appears more often in the first or in the third position of an English word.
>
> Is **R** more likely to appear in:
>
> a) The first position?
>
> b) The second position?

Representativeness/familiarity bias

Representativeness/familiarity bias is a type of base-rate neglect bias and is found when people rely on stereotypes when making decisions/investments. In the question below, subjects are considered to have the bias if they choose the second option in the question.

> Jim is an ex-college baseball player. After he graduated from college, Jim became a physical education teacher. Jim has two sons, both of whom are excellent athletes.
>
> Which is more likely?
>
> a) Jim coaches a local Little League team
>
> b) Jim coaches a local Little League team and plays softball with the local softball team

Sample-size neglect bias

Sample-size neglect bias occurs when someone makes a judgment based on a few observations which might not be representative of the whole 'sample'. The bias is present when the subject chooses the sequence in the question below that looks 'more random' (Sequence A).

> Consider the two sequences of coin-toss results shown below. Assume than unbiased coin has been used.
>
> **Sequence A**: head, tails, tails, head, tails, head
>
> **Sequence B**: head, head, head, tails, tails, tails
>
> Which of the sequences pictured do you think is more likely?
>
> a) Sequence A
>
> b) Sequence B

Framing bias

Framing bias occurs when an individual responds to a problem differently depending on its surrounding context. The bias is present if subject chooses a different program in the first question than in the second.

Question 1

> Imagine that Australia is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimate of the consequences of the programs are as follows:
>
> If Program A is adopted, 200 people will be saved.
>
> If Program B is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved.
>
> Which of the programs would you favour?
>
> a) Program A
>
> b) Program B

Question 2

> Imagine that Australia is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimate of the consequences of the programs are as follows:
>
> If Program A is adopted, 400 people will die.
>
> If Program B is adopted, there is a one-third probability that nobody will die and a two-thirds probability that 600 people will die.

Which of the programs would you favour?

a) Program A

b) Program B

Recency bias

Recency bias refers to emphasising recent events and making decisions prejudiced by them. The bias present if a subject chooses the first item in the following question, as more male names occur towards the end of the list though there are actually less male names overall.

Please read the following list of names.

Sally

Mark

Amy

Annette

Barbara

Steven

David

Michael

Donna

Press this button to continue to the next page

Did the list of names contain more male or female names?

a) More males

b) More females

Overconfidence

Overconfidence can be defined as an unwarranted faith in one's intuitive reasoning, judgements, and cognitive abilities. The questions below predict overconfidence when the confidence intervals assigned to predictions are too narrow. The correct answers are as follows: for the first question the whale is approximately 40 tons, for the second question the moon's distance is 384,400 km.

Question 1

Give high and low estimates for the average weight of an adult male sperm whale (the largest of the toothed whales) in tones. Choose numbers far enough apart to be 90 percent certain that the true answer lies somewhere between.

I am 90 percent that the average weight of a sperm whale lies between _____ and _____ tons.

Question 2

Give high and low estimates for the distance to the moon in kilometres. Choose numbers far enough apart to be 90 percent certain that the true answer lies somewhere between.

I am 90 percent that the distance to the moon lies between _____ and _____ thousand kms.

Certainty overconfidence

Overconfidence refers individual's being too certain of their own judgement. In the question below a subject is considered subject to the overconfidence bias if they choose 'above average' or 'well above average' in the question in the first question and chooses 'yes' in the second with a high degree of certainty (asked in the third question).

Question 1

Relative to other drivers on the road, how good a driver are you?

a) Below average

b) Average

c) Above average

d) Well above average

Question 2

Suppose you are aked to read this statement: 'Capetown is the capital of South Africa.'

Do you agree?

a) Yes

b) No

Question 3

Now, how confident are you that you are correct?

a) 100 percent

b) 80 percent

c) 60 percent

d) 40 percent

e) 20 percent

Illusion of control

This bias refers to the belief that one can control or at least influence outcomes when, in fact, they cannot, it has been found to contribute to overconfidence bias. The bias is present if subject chooses the first item in the following questions.

Question 1

When you participate in games of chance that involve dice – such as Backgammon or Monopoly – do you feel more in control when you roll the dice yourself?

a) I feel more in control when I roll the dice myself

b) I am indifferent as to who rolls the dice

Question 2

When and if you purchase a lottery ticket, do you feel more encouraged, regarding your odds of winning, if you choose the number yourself rather than using a computer-generated number?

a) I'm more likely to win if I control the numbers picked.

b) It makes no difference to me how the numbers are chosen.

Ambiguity aversion

This bias refers to hesitation in situations when probability is not known. The bias is present if a participant chooses to bet on the gaming machine in the following question. This is due to because betting on the gaming machine is less ambiguous despite the odds being the same for both choices.

Suppose you are a big fan of the local rugby team, the Broncos. You are sitting in the stands just prior to the start of the game, and someone you don't know approaches you and offers you a gamble. First, he ask you what the odds are the Broncos will win tonight's game. You estimate that the odds are 1 to 1 (50 percent), because the Broncos are playing the Titans, who linger midpack in the standings but overall have a good team. The man then asks you if you would be willing to bet money on the game, based on the odds. You feel confidence in your assessment, and you agree. You're surprised, however, when the man then produces a handheld, electronic gaming machine and suggests that perhaps you would rather bet on the gaming machine than on the rugby game. The machine pays off every time three cherries appear, an outcome that occurs 50 percent of the time.

Assuming that the amount of money at stake is equal in each case, which bet do you accept?

a) Bet on the rugby game

b) Bet on the gaming machine

Competence effect:

This bias refers to placing greater emphasis on one's own involvement (and consequently competence) when making a choice. In the following question the bias present if the subject chooses to bet on the rugby game although its odds are smaller.

> The scenario is the same as in the question before, but there are some differences. Suppose that you are not only a big fan of your local rugby team, the Broncos, but that you helped to put the team together and know all of the competitors in the league very well. This time, when the stranger approaches you, assume that you estimate 1 to 2 (67 percent) odds in favour of the Broncos. Since you know a significant amount about the team, you are again confident enough to accept when the man asks, given these odds, if you are willing to bet on the game. Assume that, as before, the man produces a gaming machine and says you'll win just as much money if the gaming machine produces three cherries as if the Broncos beat the Titans. This time the gaming machine pays off – that is, produces three cherries – 70 percent of the time.
>
> Which game do you choose?
>
> a) Bet on the rugby game
>
> b) Bet on the gaming machine

Mental accounting

This bias refers to people's tendencies to code, categorise, and evaluate economic outcomes by grouping their assets into any number of non-fungible (non-interchangeable) mental accounts. The bias is present if the participant answers 'no' in the first question and 'yes' in the second question.

Question 1

> Imagine that you have decided to see a play and paid the admission price of $10 per ticket. As you enter the theatre, you discover that you have lost the ticket. The seat was not marked and the ticket cannot be recovered.
>
> Would you pay $10 for another ticket?
>
> a) Yes
>
> b) No

Question 2

> Imagine that you have decided to see a play where admission is $10 per ticket. As you enter the theatre, you discover that you have lost a $10 bill.
>
> Would you still pay $10 for a ticket for the play?
>
> a) Yes
>
> b) No

APPENDIX C: Perceptions of risk

We tested the risk perception of investors towards the investment options including hybrids using a variety of questions covering different aspects of financial risk like severity of loss, poor knowledge, uncertainty of returns, trust of issuer, quality etc. We follow Diacon and Ennew[5] who developed a set of 27 questions, each of which measure an aspect of risk perception based on the well-known psychometric paradigm and used psychometric scaling methods to produce quantitative measures of perceived risk.

We initially asked participants to rate the individual investment choices in the 5 experiments on a reduced set of questions. At the end of the investment choice experiments, we let the participants rate the hybrid securities, government bonds and company shares as general investment products on the full set of questions.

Risk factors

In order to reduce the number of risk perception variables to a smaller set of key independent factors, Diacon and Ennew[6] conducted a factor analysis of the risk-related items in their questionnaire and identified five factors. We used the same five factors, provided below, in our analysis.

1. Distrust of product/issuer
2. Adverse consequence
3. Volatility of returns
4. Poor knowledge or information
5. Regulatory failure

The questions associated with each of the above factors are provided below.

Factor 1: Distrust of products/producers

1. Would you experience unacceptable sales pressure if you were considering this investment?
2. Is there a risk of receiving unsound and biased advice from those who sell or recommend this product?
3. How easy is it to observe the charges levied by the investment provider?
4. Is there a risk that you will be unable to cash in your investment at short notice without a substantial penalty?
5. To what extent are any losses from this product known immediately?

[5] S Diacon & C Ennew, 'Consumer perceptions of financial risk', *Geneva Papers on Risk and Insurance. Issues and Practice,* 2001, pp. 389–409.
[6] Diacon & Ennew

6. Do you think this investment product is easy or complex to understand?
7. Is there a risk that the company providing this product may behave unethically?

Factor 2: Adverse consequences

8. To what extent do individuals assess information on the product prior to purchase?
9. Do individual investors spend a lot of time monitoring this investment?
10. How great is the risk that you will be ruined as a result of this investment?
11. How serious could the consequences of owning this product be, should it prove unsatisfactory?
12. Could large losses or failure of this product have effects for the Australian economy?
13. How great is the risk of losing all the money you put into this investment product?

Factor 3: Volatility of returns

14. How great is the risk that the return from this investment might fall below expectations?
15. Is there a risk of losing money because the value of the investment may not rise in line with inflation?
16. How much uncertainty is there in terms of the expected return for this product?
17. How great is the risk that the return from this investment will go down as well as up?

Factor 4: Poor knowledge or information

18. Are the risks from this investment product known to financial experts?
19. Would a typical investor know about the risks involved in this investment?
20. To what extent can any losses from this product be observed by individual investors?

Factor 5: Regulatory failure

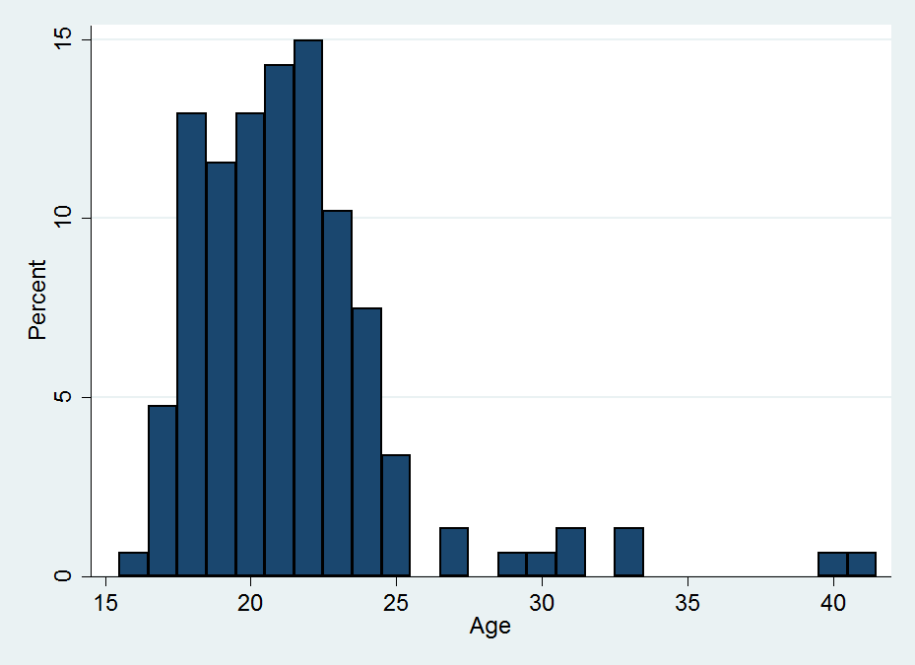
21. To what extent will the government protect investors if something goes wrong with the investment?
22. To what extent is the investment provider regulated to protect the individual's investments?

APPENDIX D: Detailed results

The experiment was conducted in May 2014 using the experimental software CORAL.[7] We held eleven experimental sessions with up to 20 subjects in each. Each session lasted approximately 45 minutes. Subjects were (mostly undergraduate) students from Queensland University of Technology, recruited via the standard software ORSEE.[8]

Our sample consisted of a fairly homogenous pool of undergraduate students. 58% were female and 42% were male students. The average age of the sample was 21 years with some variation: the youngest participant was 16 and the oldest was 41. The majority we aged between 18 and 24. This is shown in Figure 7.

Figure 7: Age distribution within sample



Most of the sample participants were studying business subjects as shown in Table 1. Nearly one fifth (20%) were studying marketing, 16% were studying accounting, 16% were studying finance, 8% were studying international business, 5% were studying economics and 3% were studying management. Around one third (34%) were studying another subject.

[7] M Schaffner, 'Programming for experimental economics: Introducing coral—a lightweight framework for experimental economic experiments', *QuBE Working Paper No. 016*, 2013, QUT Business School.
[8] B Greiner, 'An online recruitment system for economic experiments', in K Kremer & V Macho, *Forschung und wissenshaftliches Rechnen,* Gottingen, 2004, pp. 79–93.

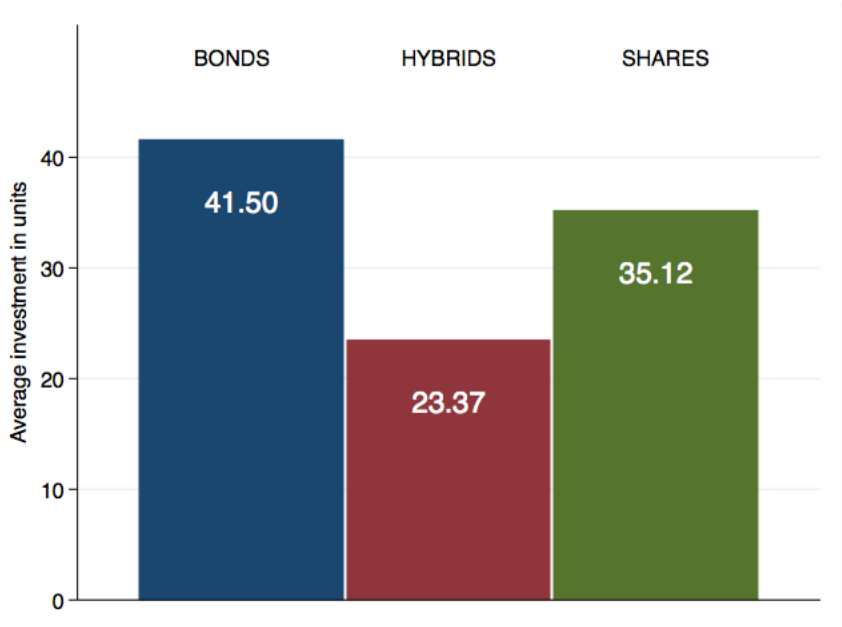
Table 1: Proportion within sample as per undergraduate major

Major	Percentage
Accounting	15.7
Economics	5.4
Finance	15.7
International Business	8.2
Marketing	18.4
Management	2.7
Something else	34

Investment choices

The average allocations in the three different investment options over the five experiments are shown in Figure 8. Among the investment choices offered, participants had a strong relative preference for government bonds, which is established in the literature as consistent with risk aversion and complexity aversion. Participants exhibited the lowest demand for the stylised hybrid securities. The average allocation to hybrids was nearly 44% lower than allocation to bonds (23% compared to 42%), and 34% lower than average allocation to shares (23% compared to 35%).

Figure 8: Average allocation of participants to different investment options



There was considerable difference in choices even within our pool of similar students. Some participants exhibited low levels of risk aversion with 10% of participants allocating between 60% and 100% to shares. On the other hand, there was also evidence of high level of risk aversion with 10% of experiment choices showing 70–100% allocation to bonds.

Generally participants responded to differences in the expected values of the investments. A concern going into the experiments was whether participant fatigue would influence the responses given the difficulty of the choices and the repetitive nature of the task. However, participants responded to the changes in expected values fairly consistently over the course of the experiment, suggesting that participant fatigue was not a concern in the experiment.

Behavioural bias within sample

Based on the participant's responses to the questions on individual behavioural biases, we segregate the responses into two categories: 'bias' and 'no bias' representing respectively the responses which show evidence of a particular bias and those which do not. The pie-charts in Figure 9 show the proportional representation of the two categories for biases where the proportion of the biased responses is significantly smaller than the proportion of those without bias in the sample. These charts show that a vast majority of the participants in our experiments did not show ambiguity aversion, mental accounting, framing or overconfidence bias. However, approximately a quarter of the sample showed evidence of bias in each case. The proportions of participants exhibiting these biases are outlined below:

- 24% of participants exhibited ambiguity bias while 76% did not;
- 25% of participants exhibited overconfidence bias while 75% did not;
- 27% of participants exhibited framing bias while 75% did not; and
- 24% of participants exhibited mental accounting bias while 76% did not.

Figure 10 shows pie-charts for those biases where there was relatively even division between participants with biases and those without it. More than 60% of the participants in our experiments exhibited illusion of control, the largest proportion for any bias in our study. Whilst participants who exhibited competence bias slightly outnumbered those that did not, those with representativeness bias were slightly outnumbered by those devoid of it. For availability bias, a much higher proportion of participants tested negative. The proportions of participants exhibiting these biases are outlined below:

- 52% of participants exhibited competence bias while 48% did not;
- 61% of participants exhibited control illusion bias while 39% did not;
- 51% of participants exhibited representativeness bias while 49% did not; and
- 39% of participants exhibited availability bias while 61% did not.

Figure 9: Pie-charts for biases Less prevalent in the sample

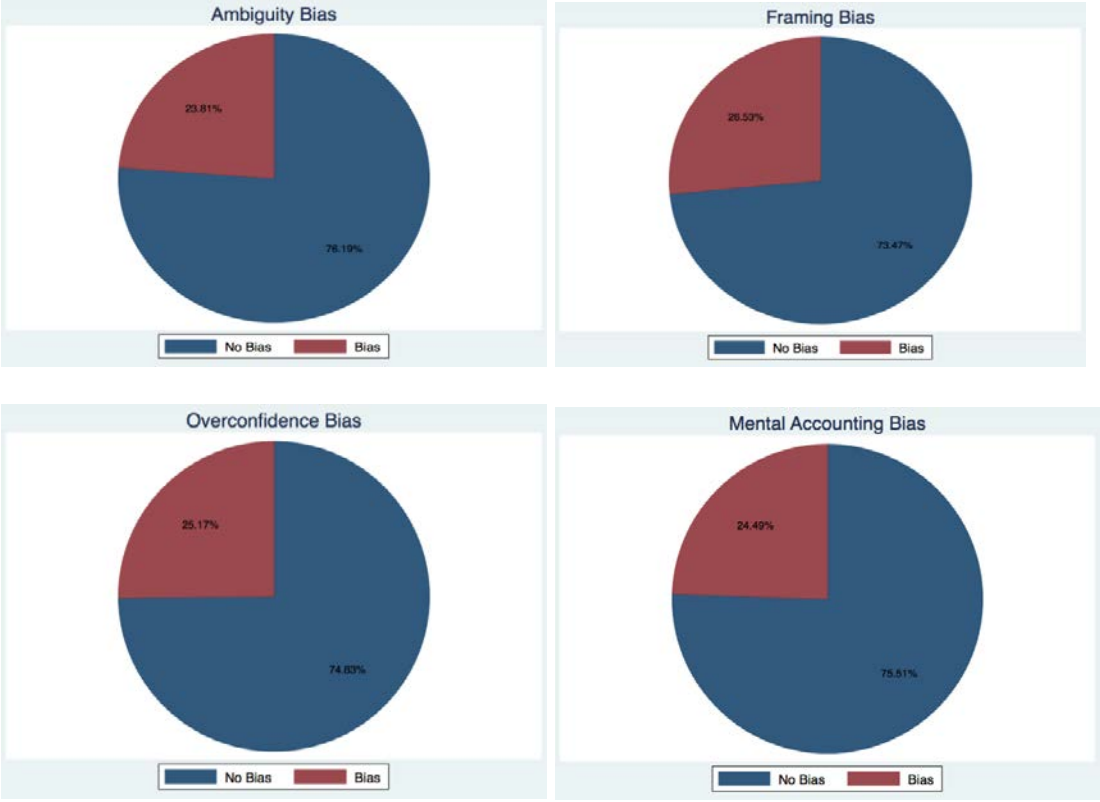
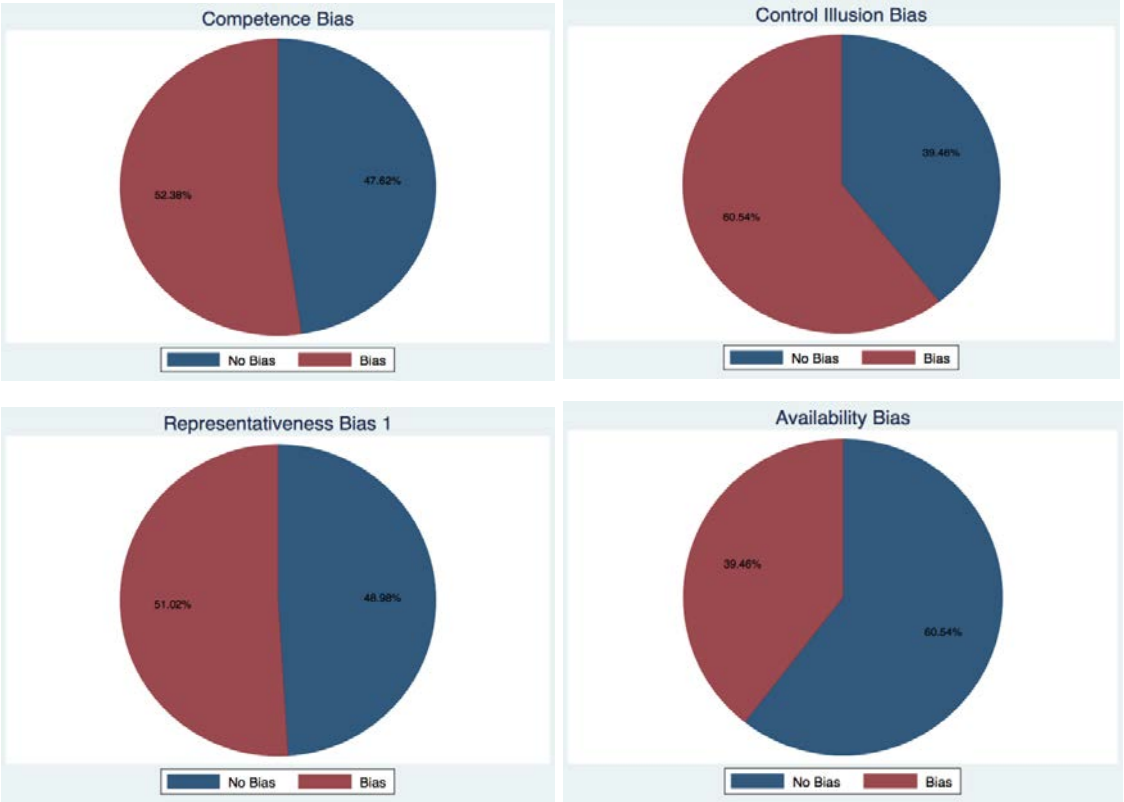


Figure 10: Pie-charts for biases more prevalent in the sample



The proportional representation of individual biases within the sample may influence the results and conclusions of the study. It needs to be borne in mind that our sample entirely consists of university students, with many of them having some training in economics, whose cognitive abilities in general could be higher than the general population. Hence, the prevalence of many of the biases among them is expected to be less than that in general population. However, for most biases, we have sufficient representation to draw reasonable inferences about their impact on participants' investment decisions.

Behavioural bias and investment choices

First, we look at the biases individually with respect to their allocation to the three investment options. The following bar charts graphically show the differences in average allocations of participants demonstrating a certain bias from those without them.

Figure 11: Allocation differences for ambiguity aversion

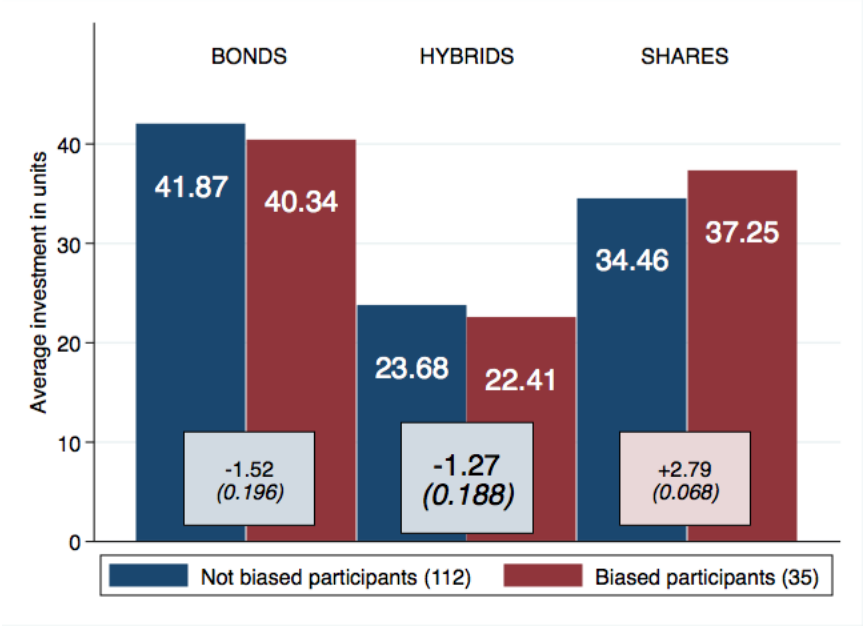
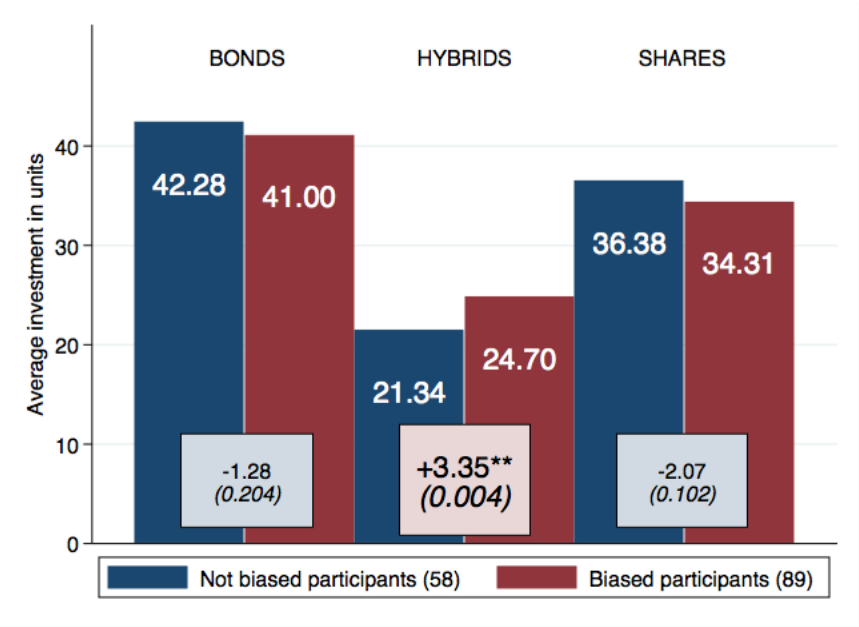


Figure 11, above, shows that for participants with 'ambiguity aversion' bias, the average allocations in bonds and hybrids are slightly lower than those without this bias. The trend is reversed for shares where average allocation is higher by 2.8 units for participants with biases compared to those without it. None of the differences are statistically significant at the 5% level.

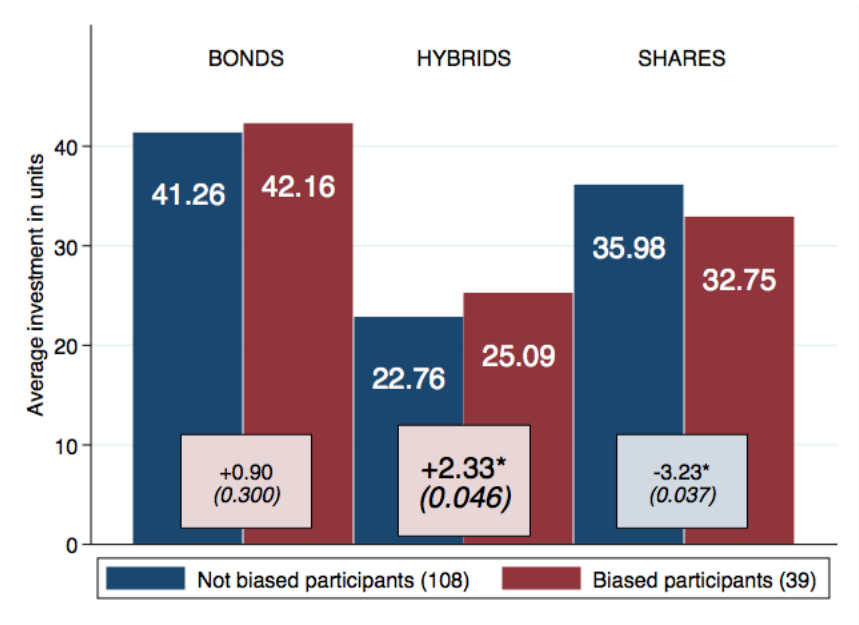
Figure 12: Allocation differences for illusion of control



Note: ***, **, * indicate significance at 10%, 5% and 1% level.

Figure 12 shows the differential average allocations across the three investment options for participants with and without the 'illusion of control' bias respectively. The average allocation in hybrids among participants who demonstrated the illusion of control bias was higher relative to that of those devoid of it. The difference of 3.35 units has strong statistical significance (p = 0.004). This is different from the trend observed in shares and bonds where average allocations were lower for participants with illusion of control bias.

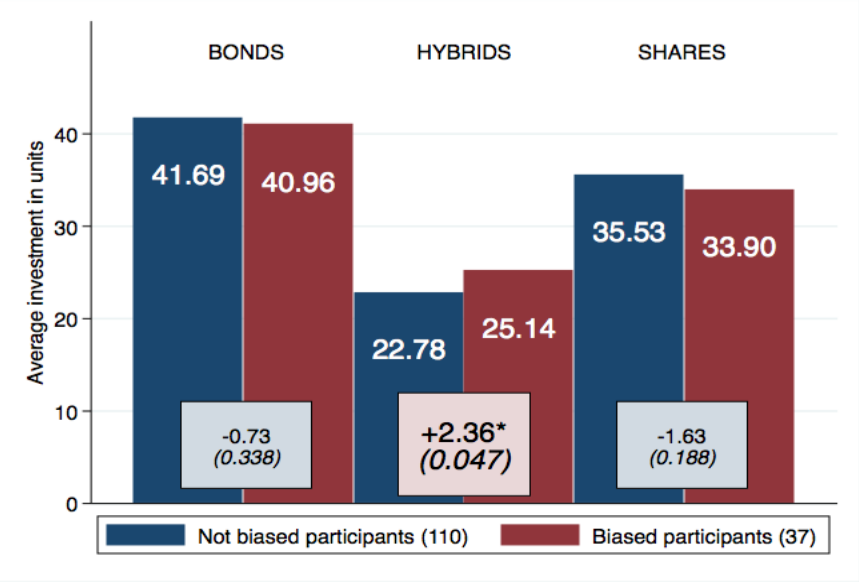
Figure 13: Allocation differences for framing bias



Note: ***, **, * indicate significance at 10%, 5% and 1% level.

Figure 13 shows the difference in allocations between participants with and without framing bias. The average allocations in bonds and hybrids were slightly higher among participants with framing bias than those who are without it. For stocks, on the other hand, average allocations were slightly lower for participants with framing bias. The difference between the two groups is significant for allocation to hybrid securities (p = 0.046) and shares (p = 0.037) but not for allocation to bonds.

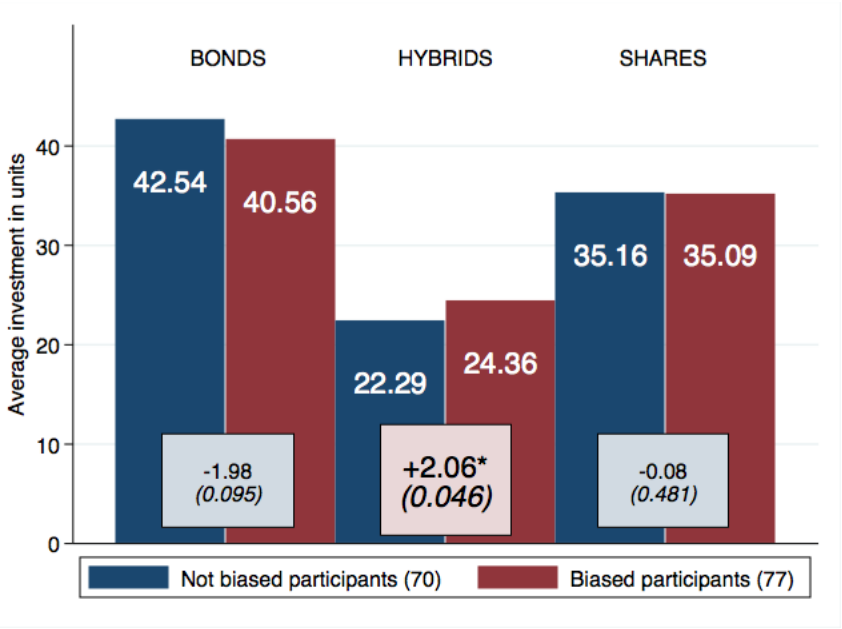
Figure 14: Allocation differences for overconfidence bias



Note: ***, **, * indicate significance at 10%, 5% and 1% level.

Figure 14 shows the average allocation differences between participants with and without overconfidence bias. Participants with bias allocate, on average, significantly more (2.36 units) to hybrids but slightly less to bonds and shares than those without it. Again, the difference between the two groups is significant for allocation to hybrid securities (p = 0.047) but not for allocation to bonds and shares.

Figure 15: Allocation differences for competence bias



Note: ***, **, * indicate significance at 10%, 5% and 1% level.

For competence bias, the average allocations across the range of investment choices are shown in Figure 15. The results are similar to those with the overconfidence bias. The average allocation in hybrids is higher for those with competence bias than that of those without it. The difference is statistically significant (p = 0.046) but the significance is weaker than that for overconfidence. For average allocations in bonds and shares, the difference between those with and without competence bias is not significant.

Next, the allocations of the participants to the three investment options were individually regressed against their behavioural biases. We find that only some of the biases are significantly related to the investment choices made by the participants. That is, other biases were not relevant to the allocation decisions. We report the regression coefficients of only the relevant biases in Table 2, below, to show their impact on the respective investment options. We also used differences in expected return (yield) as a control variable in all our regressions.

The regression results reveal several interesting findings. As expected, the yield coefficient was significantly positive in all regressions indicating the participants strongly respond to changes in expected return. None of the behavioural biases were significantly related to participants' allocation to bonds. However, this was not true for regressions with allocation to hybrids (or shares) where some of the bias coefficients demonstrate statistical significance.

Table 2: Regression results for impact of bias on investment choice

	BONDS	HYBRIDS	SHARES
Ambiguity aversion	-1.976	-1.873	3.817**
	(1.78)	(1.41)	(1.88)
Illusion of control	-0.923	3.188**	-2.342
	(1.59)	(1.26)	(1.69)
Framing bias	0.557	2.589*	-3.170*
	(1.70)	(1.35)	(1.81)
Competence	-1.587	1.513	0.148
	(1.58)	(1.25)	(1.68)
Overconfidence	0.477	1.810*	-2.289*
	(1.18)	(0.93)	(1.25)
Yield	8.755***	6.842***	6.129***
	(1.87)	(1.04)	(2.36)
Intercept	8.430	-12.156**	2.731
	(7.52)	(5.01)	(13.34)
R-Squared	0.034	0.077	0.024
F	4.22***	10.17***	3.02***
Number of Obs.	735	735	735

Note: ***, **, * indicate significance at 10%, 5% and 1% level.

The relationship between allocation to hybrids and illusion of control bias showed strong statistical significance (significant at 1% level). Other variables remaining constant, allocation to hybrids increased by 3.18 units for participants who demonstrated the illusion of control bias. Given the average allocation to hybrids was about 23 units, this represents a significant increase even in economic terms. The increased allocation to hybrids came primarily at the cost of lower allocation to shares. Allocation to hybrids also showed a positive relationship with presence of framing and overconfidence bias in participants. While the statistical significance in both cases was weaker than that for illusion of control they are still quite significant in economic terms

Allocation to shares was strongly related to ambiguity aversion bias. Other factors remaining equal, presence of ambiguity aversion in participants resulted in an allocation of 3.81 more units to shares. Again, given the average allocation of the participants to shares was about 35 units, this increase was economically as well as statistically significant. This increase in allocation to shares by ambiguity averse participants was matched by lower allocation to hybrids and bonds. Allocation to shares appeared to have a negative relationship to framing and overconfidence bias, although the significance of these effects was relatively weak.

In explaining the relationship of some of the biases to investment choices of participants, particularly in relation to allocation changes in hybrids and shares, we draw on the insights of behavioural economics literature. Human beings, when subject to illusion of control bias, feel they can exert control over their environment and influence the outcomes. They tend to gravitate towards investments over which they feel some degree of control (although

this may be illusory). In our experiments, in choosing between two risky prospects (hybrids and shares), participants showing illusion of control may feel they are more in control of investment outcomes of hybrids than shares. The returns from hybrids are relatively stable (linked to bank bill rates) compared to shares but payments can be affected by adverse events. Participants with bias may underweight the probability such adverse events as they feel 'illusory' control over outcomes.

Whilst it can be argued that the above reasoning for illusion of control also extends to shares, one has to bear in mind that the sources of uncertainty with share returns are far too many. In contrast, hybrids can suspend or defer payments only under specific conditions, which appear very restrictive. Therefore biased participants may feel more in control over outcomes of their hybrid investments than those of their share investments.

The positive (negative) relationship of ambiguity aversion bias with shares (hybrids) is unsurprising. Ambiguity aversion bias leads to a preference of known risks over unknown risks. Whilst shares may be considered riskier than the other options by the participants, they are arguably less complex than hybrids. It is conceivable that ambiguity averse participants will prefer 'higher yet familiar' risk of investing in shares to 'lower but less understood' risk of investing in hybrids.

The coefficient of overconfidence bias is positive for hybrids and negative for shares. Although these may seem counterintuitive initially, particularly the negative relationship between allocation to shares and overconfidence, plausible explanations do exist. A key aspect of risk associated with hybrids is suspension or deferment of payments in certain circumstances that are difficult to predict. However, overconfidence bias may lead participants to believe that they can assess the probabilities of the occurrence of these events with a high degree of accuracy. Overconfidence may also tend to make participants underestimate downside risk and perceive hybrids to be safer investments than they actually are. It is possible that participants demonstrating this bias may feel more overconfident when investing in hybrids than in shares if they consider that sources of risk for the latter are more numerous than the former. It may also suggest that participants see a narrower range of risk events for hybrids which may elevate their overconfidence; hence reverse causality cannot be ruled out.

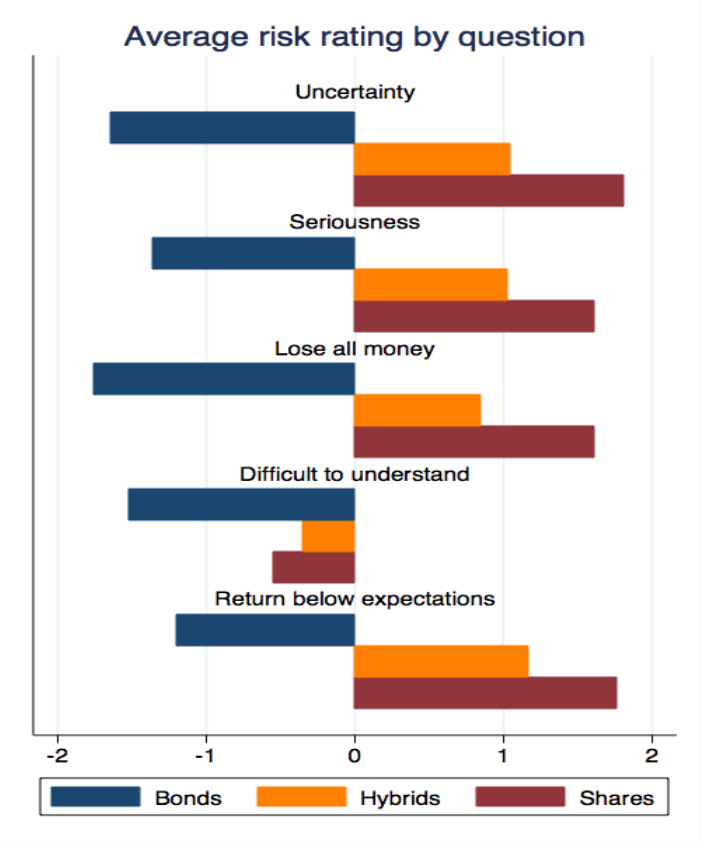
While the signs of the framing bias coefficients have same signs for hybrids and shares as overconfidence, understanding the relationships is easier. Participants susceptible to framing bias make decisions that are influenced by the formulation of the choice, that is, how it is presented. This may result in them focussing on a few specific aspects of the choice that are more obvious and ignore important information that are latent. The framing effect is likely to be more pronounced for hybrids as many of the risks are not immediately apparent rendering the risk-return trade-off more appealing than shares and bonds.

Risk perception and investment choices

Next we turn to the participant responses to the risk attitude questions. Participants were asked to rate the choices on a 7 point scale (-3 to +3) with -3 and +3 respectively denoting

the lowest and the highest perceived risk. First, we graphically present their responses to the questions accompanying the investment choice experiments in Figure 16. The bars represent the average rating the participants assigned to the individual investment choices they were confronted within the experiments.

Figure 16: Risk perception of choices within experiments

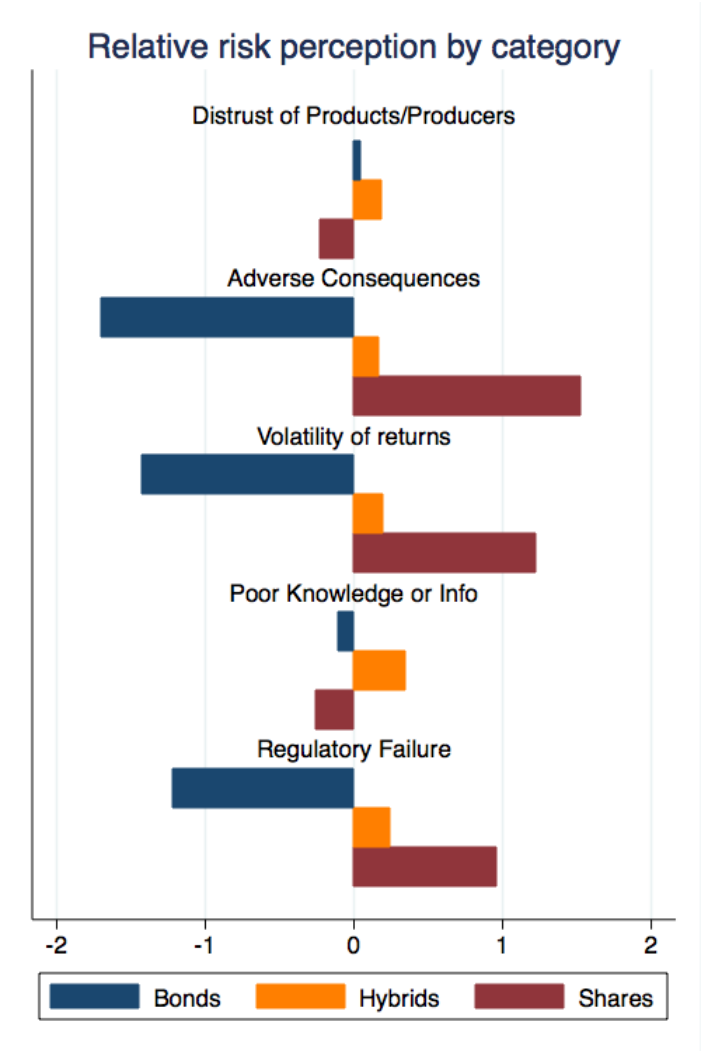


Hybrids and shares were considered to have higher risk for uncertainty, seriousness, loss of all money and receiving returns below expectations. Shares were considered more risky than hybrids for all those risk measures, while bonds were considered low risk for all measures. All three product types were considered low risk for one risk measure: 'difficult to understand', with bonds considered the lowest risk, followed by shares and then hybrids.

The results in the graph indicate that whilst participants did not find the investment options difficult to understand, they ranked hybrids below both bonds and shares in terms of difficulty of understanding. This ranking is consistent with the view that hybrids are most complex than the other investment choices offered to the participants. Yet it appears that the risk emanating from it was perceived to be relatively low compared to other risk attributes.

Next, we examine the scores on the broad risk perception factors by using a 7-point scale as described above. The results are presented in Figure 17, below.

Figure 17: Risk perception factors



Again bonds are perceived as least risky in terms of every factor except distrust of products/producers. Remarkably, shares are rated as having lower risk than both hybrids and bonds in terms of distrust of products/producers and poor knowledge factors. In both cases, the perceived risk of hybrids is the highest. These results provide important insights about investor's risk attitudes. The reputation of the issuer may seem to count more in assessment of risk for hybrids than for shares. Similarly, poor knowledge is seen more of a risk for hybrids than for bonds and shares. Interesting, hybrids are seen to have only moderate risk of suffering from adverse consequences.

We conduct regression of allocations to bonds, hybrids, and shares respectively against the risk factor scores assigned by the participants to each of those investment options in general. The results are reported in Table 3.

Table 3: Risk perception for broad factors

	BONDS	HYBRIDS	SHARES
Distrust of products/producers	-1.287***	-0.735*	-0.996**
	(0.37)	(0.40)	(0.40)
Adverse consequences	0.099	0.230	0.591
	(0.32)	(0.30)	(0.47)
Volatility of returns	0.187	-0.043	-0.363
	(0.31)	(0.34)	(0.46)
Poor knowledge or info	1.420***	-0.546	-1.097**
	(0.43)	(0.42)	(0.44)
Regulatory failure	-1.167**	-0.547	0.248
	(0.55)	(0.50)	(0.59)
Yield	8.755***	6.840***	6.394***
	(1.82)	(1.04)	(2.30)
Intercept	-6.469	10.179	-6.226
	(12.29)	(9.42)	(16.72)
R-Squared	0.090	0.085	0.096
F	4.41***	4.19***	4.76***
Number of Obs.	735	735	735

Note: ***, **, * indicate significance at 10%, 5% and 1% level.

Many of the coefficients in the three regressions lacked statistical significance. However, the coefficients that were significant generally have negative signs, which implied that all things being equal higher risk perception of an investment option will be associated with lower allocation to it. The factor with the strongest overall effect was ‘distrust of products/producers’ which had a significant negative relationship with allocation to all three investment options. The other two significant negative relationships observed were for poor knowledge or information risk and regulatory failure risk factors with share and bond allocations respectively. For hybrids, apart from ‘distrust of products/producers, no other perceived risk factor had any significant impact on allocations. The control variable ‘yield’ was significantly positive in every case as one would expect.