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AMBIGUITY AVERSION IN ASSET MARKET: EXPERIMENTAL STUDY OF HOME BIAS

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Abstract

The equity market home bias occurs when the investors over-invest in their home country assets. The equity market home bias is a paradox because the investors are not hedging their risk optimally. Even with unrealistic levels of risk aversion, the equity market home bias cannot be explained using the standard mean-variance model. We propose ambiguity aversion to be the behavioral explanation. We design six experiments using real world assets and derivatives to show the relationship between ambiguity aversion and home bias. We tested for ambiguity aversion by showing that the investor's subjective probability is sub-additive. The result from the experiment provides support for the assertion that ambiguity aversion is related to the equity market home bias paradox.

JEL classification numbers: C91, G11, G15.

Key words: Equity Market Home Bias. Mean-Variance Model. Ambiguity Aversion. Experiments.

Ambiguity Aversion in Asset Market: Experimental Study of Home Bias*

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1 Introduction

Equity Home Bias is a phenomenon in which investors over-invest in home country assets compared to what the rational model predicts. Despite the fact that, in the past 4 years, foreign stocks have been outperforming domestic stocks on average, US investors still maintain a domestic-asset-heavy portfolio. Home bias is not limited to US investors but occurs worldwide (Figure 1). There has been strong empirical support for the existence of home bias paradox and many scholars have made various arguments trying to explain this puzzle. The inflation rate, exchange rate, information asymmetry, and information immobility are some of the popular choices but none of these have been generally accepted or empirically consistent. However, these explanations are all within a rational choice framework. Here, we propose a behavioral framework, ambiguity aversion, to help better understand the cause of equity market home bias. Simply put, we argue that ambiguity aversion inhibits people from investing in unfamiliar companies. Unlike previous studies, we use an experimental design with real world assets and test for ambiguity aversion instead of using fictitious assets or simply showing home bias without an explanation.

Equity market home bias[1] presents an interesting problem because the investors are being "irrational" in the sense that they are not investing in a pareto-optimal manner: there exists another portfolio allocation such that the investor does not face any higher risk (variance) but receives higher expected return. If people are indeed being irrational with their portfolio selection, then this presents an arbitrage opportunity. In addition, the irrational behavior raises the question of why investors are not allocating risks efficiently. Our paper shows that 1) using real world assets there is home bias, and 2) the bias is

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[1]We will drop the term "equity" from here on out.

caused by ambiguity aversion by showing that the investor's subjective probability over foreign assets is sub-additive.

A common argument against ambiguity aversion is that an investor might want to invest in familiar companies because he knows how well the company will perform (i.e., informational advantage). Surely, rational choice theorists cannot use that as an argument with the Efficient Market Hypothesis looming over it (Fama 1970). However, as an outsider of the firm, it is highly unlikely that the investor has any useful knowledge. The term "familiarity" that the investor generally refers to is related to being able to answer nontechnical questions such as "What does the firm produce? Where are they located?" However, these things should be irrelevant when it comes to investing. As with the standard finance approach, what the investor truly needs to know is the expected cash flow and not what the company produces.[2]

The insights obtained through the study of home bias also help in explaining other similar behavioral phenomena. For example, an employee often times invests in the same company in which he works. However, this is not an optimal way to hedge one's risk. When Enron collapsed, the employees who also invested in Enron took a double loss by failing to insure themselves against risk. In a non-investment environment, our model can help explain some of the everyday consumer purchasing behavior, such as buying a toothpaste. Consumers are willing to pay the extra premium in order to buy toothpaste from a brand which is more familiar. Although our study is focused on the international asset market, the same phenomenon is applicable across contexts.

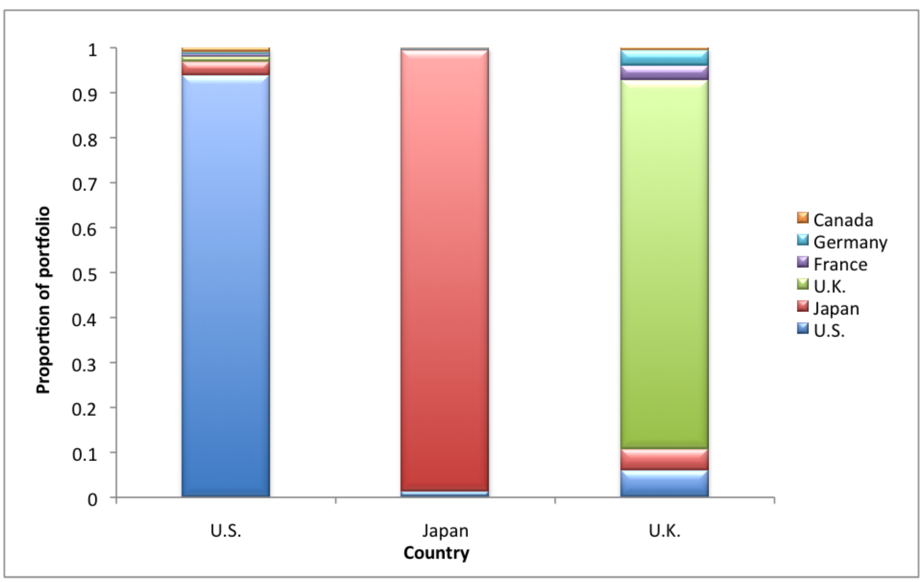


Figure 1: Portfolio Weights: US, Japanese and UK Investors
French and Poterba (1991)

[2]In terms of efficient market hypothesis, the prices should have already incorporated relevant informations.

1.1 Literature Review

In addition to French and Poterba (1991), many others have documented empirical support of home bias. Ahearne, Griever, and Warnock (2003) show that in 1997 the US stocks composed only 48.3% of the worlds stock portfolio yet US investors portfolios were composed of only 10.1% foreign stocks. Therefore, when considering the Capital Asset Pricing Model (CAPM) with the parameters specified using the world market, US investors are holding less than 1/5th of the foreign assets required to achieve the efficient frontier. Even in experimental setting, Kilka and Weber (2002) have shown the existence of home bias in Germany and United States.

To justify the discrepancy between the empirics and the rational model, a number of explanations have been suggested. One explanation is that there is capital immobility due to institutional structure. However, international barriers have been decreasing for the last 30 years yet there is no significant change in the US investors' portfolio. Moreover, most of the portfolio diversification can be obtained by trading in American Depositary Receipts (Errunza, Hogan, and Hung 1999). Also, we observe that the gross equity flow has increased while the net flow stayed constant (Bekaert and Harvey 1995). Glassman and Riddick (2001) showed that informational asymmetry cannot be a good explanation unless we are assuming that the market portfolio standard deviation is 2 to 5 times higher than what is empirically shown. Explanation using exchange rate bias is not plausible with CAPM because one can hedge the exchange rate risk by shorting risk free assets in foreign countries. Even without hedging, optimal portfolio shows that investors should diversify even with exchange rate risk. Another explanation is that the investors are trying to hedge the risk of inflation rate. However, Cooper and Kaplanis (1994) suggest that this too is not a plausible explanation unless one assumes a very high level of risk tolerance. Lastly, in theory, information asymmetry and immobility can help explain home bias (Nieuwerburgh and Veldkamp Forthcoming 2008) but one needs to assume that there is relevant information gained by non-professional traders. For more detailed review, see Karolyi and Stulz (2003) and Lewis (1999).

The study reported here provides a behavioral explanation of the home bias paradox. From the behavioral economics point of view, ambiguity aversion is a very good starting point as an explanation for the home bias paradox. For example, Bossaerts, Ghirardato, Guanaschelli, and Zame (2005) showed that asset markets do react to ambiguity aversion with fictitious assets. Our research is an experimental study which shows a positive relationship between ambiguity aversion and home bias. In particular, the experiments tested whether investors are more ambiguous when it comes to foreign stocks and how this relates to the level of home bias. Our experiments are built on Ellsberg (1961)'s example of showing ambiguity aversion.

1.2 Agenda

We begin by introducing the theory behind the mean-variance model and its implications, followed by various theories of ambiguity aversion, and non-additive subjective probability model we used for the experimental design. We present experimental results directly after presenting the design for all six experiments. First two designs target decision-making over individual companies while the last two designs target decision-making over indices. We end with a summarizing conclusion.

2 Theory

A short review of ambiguity aversion and the mean-variance model is discussed in the following two subsections. Readers who are familiar with the topic may go directly to the experimental design section. However, our experimental design is heavily based on the non-additive probability discussed in the Theory of Ambiguity Aversion section.

2.1 Mean-Variance Model and Empirical Data

We follow the argument made by Lewis (1999). The standard model used in finance is the *mean-variance* model. The utility function is called the mean-variance utility when it increases with respect to mean and decreases with respect to variance. In particular, it has the following form: $U = U(E_t W_{t+1}, Var(W_{t+1}))$ where W_t is the wealth at time t, $Var(\bullet)$ is the variance-covariance matrix and E_t is the expectations operator taken at time t. Furthermore, assume that $\frac{\partial U}{\partial W_t} > 0$ and $\frac{\partial^2 U}{\partial W_t^2} < 0$. Denote α_t, β_t as the proportion of wealth held in domestic and foreign assets at time t, respectively. Hence $\alpha_t + \beta_t = 1$. Define $r_t = (r_t^D, r_t^F)$ as turn on domestic assets and foreign assets at time t. For example, one may consider the following utility function with all the desired properties: $W_t(1+E_t r_{t+1}) - \gamma Var(W_t E_t r_{t+1})$ where γ is the risk aversion parameter. Now, solving for the first order condition of the objective function, the optimal proportion of foreign holding is:

$$\beta_t = \frac{(E_t r_{t+1}^F - E_t r_{t+1}^D)/\gamma}{var(r^F - r^D)} + \frac{\sigma_D^2 - \sigma_{FD}^2}{var(r^F - r^D)} \tag{1}$$

where $\gamma = \frac{-2W_t U_2}{U_1}$ is the relative risk aversion.

Consider the result from Equation 1. As the level of relative risk aversion increases, foreign investment decreases. However, there is a bound on how little one should invest in foreign companies. In particular, the bound is $\frac{\sigma_D^2 - \sigma_{FD}^2}{var(r^F - r^D)}$, which is empirically greater than zero. Table 1 shows how much one should hold in foreign assets for a given relative risk aversion.

Using the empirical data provided from Table 1 and optimal foreign holdings by Equation 1, even as relative risk aversion goes to infinity, one should still invest 39.5% of his shares in foreign assets. However, we observe approximately only 8% of the total investments are directed to foreign assets. Hence, using the mean-variance model, even with unrealistic amount of risk aversion, the level of home bias cannot be explained.

2.2 Theory of Ambiguity Aversion

Decision theorists have defined and modeled ambiguity in several ways. The most intuitive way of defining *ambiguity* is that the individual is uncertain about the distribution of the risk (Knight 1921). More uncertain the individual is about the distribution implies

Summary Statistics of Returns								
	US	Canada	France	Germany	Italy	Japan	UK	EAFE
Mean	11.14	9.59	11.63	11.32	5.81	14.03	12.62	12.12
SD	15.07	18.66	23.33	20.28	26.18	22.50	23.97	16.85
Correlations								
US	1.00	0.70	0.44	0.36	0.22	0.26	0.51	0.48
Canada	-	1.00	0.43	0.31	0.29	0.27	0.52	0.49
France	-	-	1.00	0.60	0.42	0.39	0.54	0.65
Germany	-	-	-	1.00	0.37	0.37	0.43	0.62
Italy	-	-	-	-	1.00	0.38	0.35	0.51
Japan	-	-	-	-	-	1.00	0.36	0.86
UK	-	-	-	-	-	-	1.00	0.71
EAFE	-	-	-	-	-	-	-	1.00
Foreign Portfolio Shares in Percent of Wealth								
	Actual	$\gamma = 1$	$\gamma = 2$	$\gamma = 3$	$\gamma = 10$	Minimum Variance		
β	8.00	75.9	57.7	51.6	43.1	39.5		

Table 1: Summary Statistics of International Equity Market
Data are from Morgan Stanley, from Jan 1970 to Dec 1996

a higher level of ambiguity. For example, the probability distribution of a coin toss has very little ambiguity (close to 50/50) but the probability distribution of the weather in Tajikistan (without looking it up on the internet) is pretty uncertain. To say that a person is *ambiguity averse* is to say that a person prefers to bet on an event where he knows more about the distribution. For example, I would rather bet on whether the next coin toss will turn up heads than bet on whether the weather in Tajikistan today is between 40-50 degrees.

Although seemingly intuitive, formal modeling of ambiguity has taken many different approaches. One model assumes that the utility from ambiguous events are less than the utility from unambiguous events (Sarin and Winkler 1992, Smith 1969). Another approach lets the weights of ambiguous probability be different from the weights on unambiguous probability when calculating the expected utility (Einhorn and Hogarth 1985, Segal 1987). Epstein (1999) states that there are multiple priors to the probability distribution. Another popular model often used, similar to the multiple priors approach, provides a range of probability for an event (i.e., probability of $X \in [0.3, 0.7]$) instead of a point mass probability (i.e., probability of $X = 0.5$) (Gilboa and Schmeidler 1989). The approach we use is from Schmeidler (1989) which is derived from Choquet (1953-1954), where we relax the assumption that the probability must add up to 1. We call this approach the *non-additive probability* approach.

In non-additive probability approach, we keep the assumption that the probabilities are monotonic ($p(E) \leq p(F)$ if $E \subseteq F$) but not necessarily additive ($p(E \cup F) \neq p(E) + p(F) - p(E \cap F)$). In this model, we measure the level of ambiguity by the level of sub-additivity. In other words, while $p(A)$ and $p(B)$ are the likelihood of the events A and B, $1 - p(A) - p(B)$ measures the lack of "faith" in those likelihoods. Therefore, bigger sub-additivity $(1 - p(A) - p(B))$ implies higher levels of ambiguity.

Again, an interested reader may refer to Camerer and Weber (1992) for more detailed discussion and Epstein (1999) for more rigorous treatment.

3 Materials and Methods

A total of 55 people participated in this experiment; 47 were graduate and undergraduate students from the California Institute of Technology (Caltech) and 8 were not Caltech affiliates. The participants were recruited using the Social Science Experimental Laboratory (SSEL) announcement system and public fliers. All participants were registered subjects with SSEL (signed a general consent form) and this experiment was approved as an exemption by the local research ethics committee. The experiment was conducted at the SSEL located at Caltech, Pasadena, CA. The lab consists of 30 working computers divided into a cubical setting. Subjects were physically prevented from viewing another student's computer screen. The subjects were paid a show-up fee of $10 in addition to extra earnings based on their performance in the experiment.

The experimental designs dealing with individual companies (experiments 1-4) were programmed using PHP[3] and MySQL[4] and are divided into four parts plus a survey section. The experimental designs dealing with indices (experiments 5-6) were programmed using E-prime[5] and are divided into two parts plus a survey section. Instructions were given prior to each section and were available both in print as well as on screen. We quizzed the subjects after the instruction to insure they understood the experiment. The instructions provided to the participants are attached as an Appendix.

[3] www.php.net

[4] www.mysql.com

[5] www.pstnet.com/products/E-Prime

4 Control Experiment: Ellsberg Paradox

4.1 Experimental Summary and Motivation

We used the Ellsberg's standard two urns and two colored balls experiment as the control treatment (Ellsberg 1961). An ambiguous urn, urn 1, contains 100 balls with unknown distribution of red and black. A risky urn, urn 2, contains 100 balls of which 50 are red and 50 are black. There is risk with urn 2 while uncertainty with urn 1. This baseline treatment is conducted to obtain an approximation of which of the investors are ambiguity averse and not ambiguity averse. The experimental structure below depicts how we go about in eliciting preference for ambiguity.

4.2 Experimental Structure

Ellsbergs experiment was administered to the investors in the following manner:

1. Investor is presented with two urns.
   (a) Urn 1 contains 100 balls but the number of black or red balls is unknown.
   (b) Urn 2 contains 100 balls, of which 50 are black and 50 are red.
2. Setting one: Investor is asked to pick from the following two gambles.
   (a) $x dollar if red ball is drawn from urn 1.
   (b) $x dollar if red ball is drawn from urn 2.
   (c) Indifferent.
3. Setting two: Investor is asked to pick from the following two gambles.
   (a) $x dollar if black ball is drawn from urn 1.
   (b) $x dollar if black ball is drawn from urn 2.
   (c) Indifferent.

We determined whether the investor is ambiguity averse or not by the choices he makes in this Ellsberg experiment. In particular, if the investor chooses the gamble from urn 2 (risky urn) in both settings, then we inferred that the investor was ambiguity averse. By choosing urn 2 in the first setting, it implies that the expected utility from gamble two is greater than the expected utility from gamble one. If the investor chooses urn 2 in the second setting, it implies that the expected utility from the gamble two is greater than gamble one. The following proposition will show why this leads to sub-additive probability, and therefore, ambiguity aversion.

Proposition 4.1 *Under the expected utility maximization framework, choosing the risky urn in both setting implies sub-additive probability measure.*

Proof: Choosing gamble two in the first setting implies that

$$p(red\ ball|urn\ 2)u(\$x) > p(red\ ball|urn\ 1)u(\$x)$$

$$\Longleftrightarrow$$

$$p(red\ ball|urn\ 2) > p(red\ ball|urn\ 1) \tag{2}$$

Choosing gamble two in the second setting implies that

$$p(black\ ball|urn\ 2)u(\$x) > p(black\ ball|urn\ 1)u(\$x)$$

$$\Longleftrightarrow$$

$$p(black\ ball|urn\ 2) > p(black\ ball|urn\ 1) \tag{3}$$

Since urn 2 has 50 black and 50 red balls, it must be that $p(black\ ball|urn\ 2)+p(red\ ball|urn\ 2) = 1$. From Equation 2 and 3, this implies that $p(black\ ball|urn\ 1) + p(red\ ball|urn\ 1) < 1$, which leads to a sub-additive probability measure. ∎

4.3 Results

From the Ellsberg's urn experiment, we found 48.65% of the subjects to be *ambiguity averse*. We classified the subject as ambiguity averse if he chose option (b) in both settings one and two. If the subject chose a mixture of (a), (b) or (c), this classified him as *undetermined*, choosing option (a) in both settings classified him as *ambiguity preferred*, and choosing option (c) in both settings classified him as *ambiguity neutral*. Refer to Table 2 to see the complete breakdown. For the rest of the paper, when we refer to an *ambiguity averse* subjects, we are referring to the 48.65% of the subjects who were classified as ambiguity averse. We refer to the complement of the ambiguity averse population as the *non-ambiguity averse* subjects.[6] One caveat is that, just as people show different risk preference (although correlated) for different tasks, the same holds true for ambiguity preference for different tasks.

Type	Proportion (%)
Ambiguity Averse	48.65
Ambiguity Neutral	37.84
Ambiguity Preferred	2.70
Undetermined	10.81
Number of Obs: 37	

Table 2: Sample Population's Classification of Ambiguity Preference

[6]We do not have records of the results on the Ellberg's urn experiment for subjects from session 1 of the indices experiment due to technical error.

5 Experiment 1: Portfolio Building

Definition 1 *A derivative is called a* ***Digital Option*** *if it provides a fixed return after reaching the strike price on the maturity date.*

A digital option is often called an *Arrow Security* by economists. Consider the following example of a digital option. A *digital call option* with strike price k and payment r is denoted as $C(r,k)$ which pays zero if the stock price $s < k$ and r if $s \geq k$ at the maturity date. A *digital put option* with strike price k and payment r is denoted as $P(r,k)$ which pays zero if the stock price $s > k$ and r if $s \leq k$ at the maturity date.

5.1 Setup for Individual Stocks, Experimental Summary, and Motivation

A motivation for this experiment is to test whether there is home bias in our sample, as well as how the company choices are correlated with ambiguity aversion. We presented a collection of 23 domestic and 27 foreign companies to the investor in a random order. These companies were all from the technology and semiconductor industry to minimize the industry bias. In addition, these are companies listed as the 50 biggest companies in the world with respect to their industry by Forbes 2004 magazine.[7] Along with a company name the investors were given their company's ticker symbol, headquarter location, as well as a brief list of company information which was provided by finance.google.com. Investors were asked to choose 15 companies to place a digital put option order and 15 companies in a digital call option order. One option was given per company chosen by the investor. These digital options had a maturity date of one week and strike price equal to the stock price at the day of the experiment. The investors were restricted from using any tools other than the software required for the experiment. In addition, the investors were not allowed to list a company for both a put and a call option. The investors were paid based on the performance of their portfolio after the maturity date of the options which paid \$0.50 per option exercised.

This study answers two major questions. 1. Do investors show signs of home bias? 2. What is the relationship between ambiguity aversion and home bias? We expect to see the proportion of domestic companies chosen to be greater than $23/50 = 46\%$. In addition, we expect to see a positive correlation between the level of home biasness and ambiguity.

[7] "Biggest company" was measured by a composite of sales, profits, assets, and market value. The list spans 51 countries and 27 industries.

5.2 Results

Refer to Figure 2 for the average portfolio composition. We tested the hypothesis of home bias. On average, US companies comprised 52.70% (SE=3.05) of the call options and 49.21% (SE=2.54) of the put options, which gave a total of 50.95% (SE=1.30) investment in US companies. The investors were no more likely to choose call options for US companies nor were they more likely to choose a put option for US companies. Given that the US companies consisted of only 46% of the possible companies available to choose, this suggests that there is a home bias level of 4.95% where the differences are significant at $p < 0.01$. This is a modest result but this may be caused by the fact that the experiment limits the industry choice and investors are required to choose 30 companies.

Despite the fact that half of our subjects were considered to be ambiguity averse from Ellsberg's experiment, we do not find a difference between the ambiguity averse and non-ambugity averse individual when it came to levels of home bias in their portfolio. In fact, we did not find any correlation between the result from the Ellsberg treatment and total composition of one's portfolio.

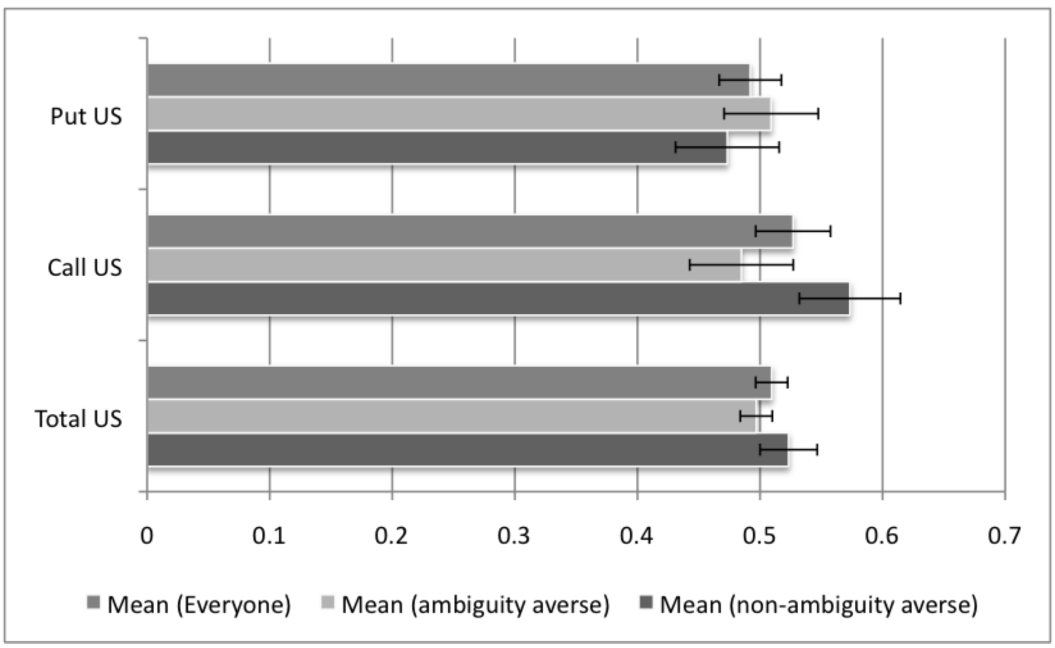


Figure 2: Share of US Companies in Portfolio

6 Experiment 2: Bond or Options?

6.1 Experimental Summary and Motivation

In this experimental design, the investor was shown one company at a time and was asked to choose one of the three gambles. *Gamble 1* is to receive a bond which pays \$1 one week later, *Gamble 2* is to receive a digital call option with exercise value \$1 and *Gamble 3* is to receive a digital put option with exercise value \$1. These options are identical to the previous section minus the exercise value. However, the investor also faced a known risk in a sense that, having chosen gamble 1, he has P probability of actually receiving the bond. Also, by choosing a gamble 2 or 3, he has $1 - P$ probability of actually receiving the options. In this setting, the probability of receiving the security of choice becomes an implied cost: lower the probability implies a higher cost. (Refer to the experimental instructions for a detailed example.)

Each investor gets three domestic companies with $P = 33\%$, three foreign companies with $P = 33\%$, three domestic companies with $P = 29\%$ and three foreign companies with $P = 29\%$. The companies were randomly selected for each investor. Investors were paid based on the performance of every trial. After completing the entire experiment (after part 4), the investors were asked for the level of familiarity of these 12 companies in the survey section.

Implied assumption is that the subjective probability belief over the stock prices is independent of the probability of receiving the security (bond and options). With this assumption, Proposition 2 claims that regardless of the belief over the performance of the stocks, choosing a bond will imply that the investor is exerting ambiguity aversion (via sub-additive probability).

Proposition 6.1 *With any probability $p < 33\%$ in the above setting, selecting a bond will lead to a sub-additive probability measure. In addition, as p decreases, the level of sub-additivity of the probability measure increases, which implies higher level of ambiguity aversion.*

Proof: Denote x as an event of receiving the bond and y as an event of receiving the option. Denote v as an event of increase in price and w as an event of decrease in price of the company's stock. By assumption, $p(y \cap v) = p(y)p(v)$ and $p(y \cap w) = p(y)p(w)$. $bond \succ put \iff p(x)u(\$) > p(y \cap v)u(\$) = p(y)p(v)u(\$) \Rightarrow p(x) > p(y)p(v)$ hence $p(x)/p(y) > p(v)$. Similarly, $bond \succ call \iff p(x)/p(y) > p(w)$. We observe that $p(w) + p(v) < 2p(x)/p(y)$. If $p < 33\%$, then we have $p(w) + p(v) < 66/67 < 1$, hence sub-additive probability measure. Notice as p decreases, $2p(x)/p(y)$ also decreases. Therefore, the level of sub-addivity of the probability measure increases as p decreases. ∎

This section addresses four major questions: 1. Is there a difference in the level of familiarity between domestic and foreign companies? 2. What is the relationship between the level of familiarity and individual choices? 3. Are investors more likely to show higher levels of ambiguity aversion in foreign companies compared to the domestic companies? And most importantly, 4. Are ambiguity averse investors more likely to choose bonds than others?

6.2 Results

This section provides the most significant result out of all designs related to individual companies.

The familiarity of companies were coded using the following method. Investors were asked during the survey section to state the level of familiarity from "never heard of it", "not familiar", "somewhat familiar", "familiar", and "very familiar." We then coded the dummy variable using 1 to 5 from "never heard of it" to "very familiar" in increasing order ($\mu = 2.18, \sigma = 1.30$).

Table 3 presents a simple relationship from the experimental data. In particular, it addresses whether there is a relationship between familiarity and individual choices. We see that investors are indeed more familiar with US companies than foreign companies ($\rho = 0.24$, $p < 0.01$). Next, we obtain a significant correlation between investment decision and ambiguity classification ($\rho = -0.16$, $p < 0.01$). This states that people who were classified as ambiguity averse are more likely to choose to receive a bond in this experimental treatment. Table 3 suggests that the type of option chosen (call vs put) is not influenced by ambiguity aversion, country origin of asset, level of ambiguity, or familiarity.

Refer to the graph in Figure 3. Here, we present the percentage that an option was chosen instead of a bond. On average, we find that an option was chosen in 73% of the trials. We further divide the group to compare the decisions made by ambiguity averse and non-ambiguity averse individuals, and then further divided the sample by focusing on domestic and foreign assets. First, we observe that investors classified as ambiguity averse are more likely to choose an option compared to non-ambiguity averse investors ($\mu_{non-ambiguity\ averse} = 0.81 \neq 0.67 = \mu_{ambiguity\ averse}$, $p < 0.01$). Furthermore, we observe that ambiguity averse individuals are more likely to receive a bond over option when faced with foreign companies ($\mu_{non-ambiguity\ averse} = 0.85 \neq 0.71 = \mu_{ambiguity\ averse}$, $p < 0.1$) or US companies ($\mu_{non-ambiguity\ averse} = 0.77 \neq 0.62 = \mu_{ambiguity\ averse}$, $p < 0.1$). Therefore, Figure 3 supports our theory and shows that ambiguity averse individuals are more likely to select a bond, in turn, showing a higher rate of sub-additivity in probability.

Next, we divide the sample to see the aggregate rate of option chosen for different levels of familiarity between ambiguity averse and non-ambiguity averse individuals in Figure 4. While we do not find significant difference between rate of option chosen between ambiguity averse and non-ambiguity averse investors for high levels of familiarity (≥ 3), we find significant differences when the familiarity is low. This is expected since ambiguity aversion is more salient when the asset is not familiar. When familiarity level is

1, we find that $\mu_{non-ambiguity\ averse} = 0.87 \neq 0.65 = \mu_{ambiguity\ averse}$, $p < 0.01$, which means ambiguity averse investors are more likely to choose a bond conditioning on familiarity level being 1. When familiarity level is 2, we also find a statically significant differences: $\mu_{non-ambiguity\ averse} = 0.81 \neq 0.58 = \mu_{ambiguity\ averse}$, $p < 0.1$. Again, these results support our theory: when people are unfamiliar with an asset, it creates higher rate of ambiguity, in turn, they are more likely to choose a bond. When people are familiar with an asset, the two class of investors behave in a similar manner.[8]

Table 4 represents three different random-effects logistical regression models. All three regressions takes the following functional form in Equation (4):

$$decision_{ij} = \alpha + \beta_1 \text{ambiguity averse}_i + \beta_2 \text{us asset}_j + \beta_3 \text{high ambiguity} + \beta_4 \text{familiarity}_{ij} \tag{4}$$

where i is the index for the individuals and j is the index for the companies. For example, familiarity_{ij} means individual i's familiarity for company j. For the random-effects model, we panel the data by individual i: therefore, the number of groups equal the number of subjects and each panel contains all the choices made by that particular individual. The three different regression models are: *All Assets*, *Familiar Assets*, and *Unfamiliar Assets*. As the names indicate, we restrict our attention to a subset of observations for those analyses. *Familiar Assets* restricts attention to assets with familiarity levels 3 to 5 while *Unfamiliar Assets* are restricted to familiarity levels 1 and 2. The $decision_{ij}$ variable took a value of 1 if the investor i chose to receive an option for company j and 0 if a bond. Ambiguity averse took a value of 1 if the individual i was classified as ambiguity averse, 0 otherwise. US asset is a dummy variable representing whether the company j is from US. High ambiguity is also a dummy variable, taking a value of 1 during $P = 29$ treatment. Lastly, familiarity took a value ranging from 1 to 5, least to most familiar.

From *All Assets* regression, we find that investors are more likely to choose to receive an option when familiarity is higher ($\beta_4 = 0.262$, $p < 0.1$). As expected, familiarity plays a even a stronger and positive role when an asset is familiar ($\beta_4 = 1.584$, $p < 0.05$ under *Familiar Assets* regression), and it is not significant when it comes to *Unfamiliar Assets* regression. In other words, familiarity matters when the investor is familiar with the asset and the relationship is positive. The high ambiguity independent variable is positive in all 3 regressions, which means that investors are more likely to select an option if the required level of sub-additivity increases. Notice that the US assets independent variable is significant under *All Assets* and *Unfamiliar Assets* regressions only ($p < 0.05$). Furthermore, the coefficients are negative: $\beta_2^{allassets} = -0.765 > \beta_2^{unfamiliarassets} = -0.848$. This suggests that people are more ambiguity averse when it comes to unfamiliar US assets compared to unfamiliar foreign assets. This observation is also supported in Figure 3 by showing a higher rate of selecting the bond option for US compared to foreign assets. The key is that the β_2 is significant for the unfamiliar assets. Lastly, consider the independent variable titled ambiguity averse. This variable takes 1 if the investor is

[8]Although not statistically significant, what we observe is that with familiar assets, ambiguity averse individuals are more likely to take the option than the bond compared to non-ambiguity averse people.

classified as ambiguity averse and 0 otherwise. Under the *All Assets* regression, it has a weakly significantly and negative coefficient ($\beta_1 = -1.015$, $p < 0.15$ two-tailed test), which correctly suggests that ambiguity averse individuals are more likely to take the bond over the asset. Furthermore, the ambiguity averse variable is not significant when it comes to *Familiar Assets* regression, since people are indeed not ambiguous when it comes to these assets. Lastly, when considering the *Unfamiliar Assets* regression, we obtain a even more negative and statistically significant coefficient, as one would expect if our theory were to hold true ($\beta_1 = -1.275$, $p < 0.05$).

In summary, our data suggests that: 1. subjects are more familiar with the US assets, 2. subjects are more likely to choose a bond when they are less familiar with the company, 3. subjects do not show higher rate of ambiguity aversion to foreign assets per se; they are ambiguity averse towards less familiar companies which are more likely to be foreign, 4. in fact, subjects are more likely to dislike unfamiliar US assets compared to unfamiliar foreign assets and 5. subjects who are classified as ambiguity averse are more likely to choose a bond.

	Ambiguity Averse	US Asset	High Ambiguity	Familiarity	Decision	Option Type
Ambiguity Averse	1					
US Asset	0	1				
High Ambiguity	0	0	1			
Familiarity	-0.05	0.24***	0.02	1		
Decision	-0.16***	-0.10	0.31***	0.07	1	
Option Type	0.11	0.06	-0.00	-0.03	.	1

*p < 0.1, **p < 0.05, ***p < 0.01. (Two-tailed test)

Number of Obs: 252. Number of Obs for Optiontype: 185

Table 3: Correlation Relationship

Ambiguity Averse: 1 if true, 0 otherwise. US Asset: 1 if true, 0 otherwise. High Ambiguity: 1 if P = 29%, 0 if P = 33%

Familiarity: from 1-5. Decision: 1 if Option, 0 if Bond. Option Type: 1 if Call, 0 if Put

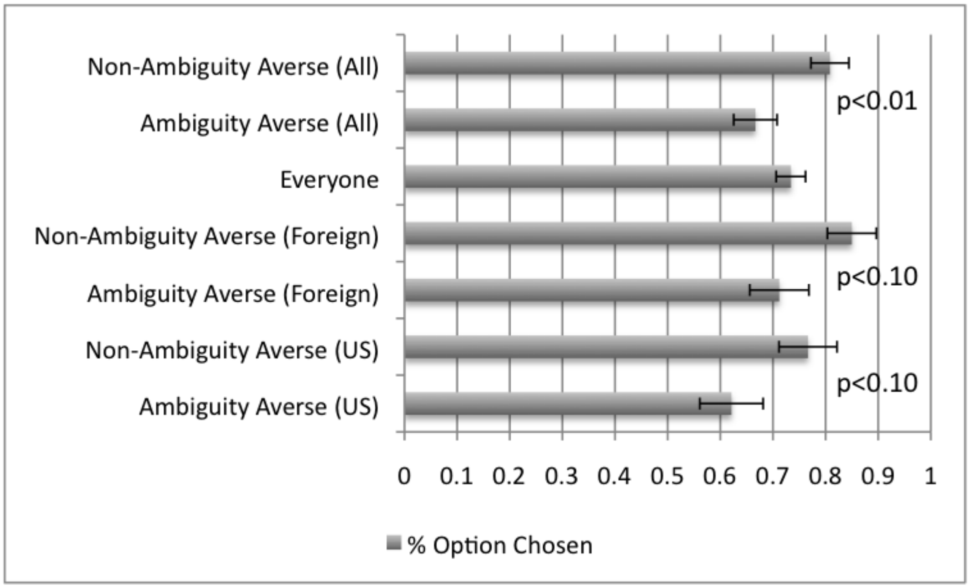


Figure 3: Decision Comparison: By Ambiguity and Origin of Assets

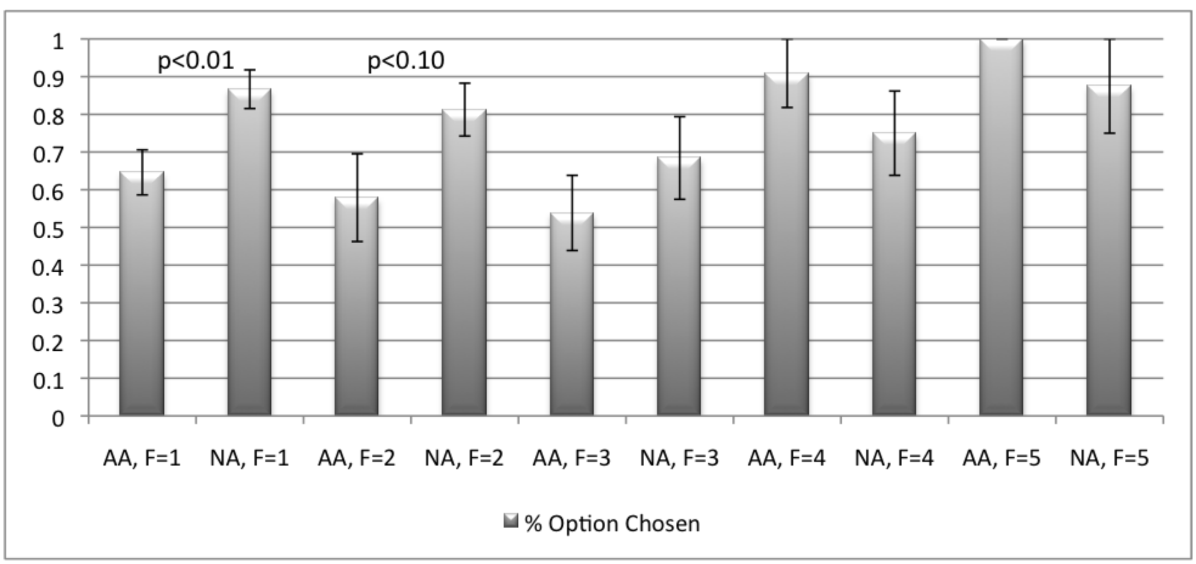


Figure 4: Decision Comparison: By Ambiguity and Familiarity

AA: Ambiguity Averse. NA: Not Ambiguity Averse. Fi: Familiarity level i

Dependent Variable: Decision = 1 if Option and 0 if Bond			
Ind. Variables	All Assets	Familiar Assets	Unfamiliar Assets
Constant	0.899	-4.343**	1.762*
	(0.631)	(2.201)	(0.942)
Ambiguity Averse	-1.015$^{\#}$	-0.112	-1.275**
	(0.679)	(0.876)	(0.621)
US Asset	-0.765**	-0.873	-0.848**
	(0.358)	(0.747)	(0.431)
High Ambiguity	1.989***	1.930**	1.544***
	(0.392)	(0.761)	(0.462)
Familiarity	0.262*	1.584**	-0.060
	(0.158)	(0.683)	(0.518)
Log likelihood	-116.919	-40.682	-77.758
All Assets: Number of Obs: 252. Number of Groups: 21			
Familiar Assets: Number of Obs: 91. Number of Groups: 21			
Unfamiliar Assets: Number of Obs: 161. Number of Groups: 21			
$^{\#}$p<0.15, *p < 0.1, **p < 0.05, ***p < 0.01. (Two-tailed test)			
Numbers in parentheses are standard errors			

Table 4: Random-Effects Logit Regression: Decision

Variables are defined in the same manner as Table 3

Familiar Assets model restricts attention to assets with familiarity level greater than 2

Unfamiliar Assets model restricts attention to assets with familiarity level less than 3

7 Experiment 3: Company Preference

7.1 Experimental Summary and Motivation

In this part of the experiment, the investors are shown two companies (A and B) and asked to choose one of the three gambles: *Gamble 1*: A outperforms B, *Gamble 2*: B outperforms A and *Gamble* 3: A equals B. The term outperform means that the percent change in the company's stock price is higher than the other companys percent change one week from the day of the experiment. For the purpose of payment, we randomly selected one of the trials the investor went through and paid \$5 if he made the correct choice.

The key to this experiment is how the two companies are populated. Recall that from experiment 1, the investor specified his portfolio. Using this portfolio, the experiment is programmed to ask for comparison between US companies with put requests and foreign companies with call requests. In addition, the experiment also asked for a comparison between US companies with call requests and foreign companies with put requests. Given that the investor requested a put option for one company and a call option for another company, he should take the gamble which states the call company will outperform the put company. If the investor selects the US company which he requested a put option for over the foreign company which he requested a call option for, by the proposition below, the investor is showing ambiguity aversion against the foreign company.

Proposition 7.1 *After choosing a put option for company A and a call option for company B, stating that company A will outperform company B leads to a sub-additivity in probability measure.*

Proof: Denote v as an event of increase in price and w as an event of decrease in price of the company's stock price. Having chosen a put option for company A implies that $p(w|A) > p(v|A)$. Having chosen a call option for company B implies that $p(v|B) > p(w|B)$. Stating that company A will outperform company B implies that $p(v|A) > p(v|B)$. Since p is a probability measure, highest $p(v|A)$ can be is $1/2$. Therefore, $1/2 > p(v|B) > p(w|B)$ hence $p(v|B) + p(w|B) < 1$. ∎

This design addresses the following major questions. 1. Do the investors consistently prefer the US companies over the foreign companies? 2. Are the investors who showed signs of ambiguity aversion during the Ellsberg setting (experiment 1) more likely to choose US (put) companies over foreign (call) companies?

7.2 Results

In short, we do not find any statistically significant results from this experimental study.

To support that there is sub-additive probability beliefs towards foreign companies, one would expect to see a higher rate of choosing US put over foreign call gambles compared to choosing foreign put over US call gambles. In our data, when investors were making a decision between US put company and foreign call company, investors preferred the US put over foreign call 22.59% (SE=4.58%) of the time (Figure 5). In other words, the investors exhibited sub-additivity 22.59% of the time. However, when faced with US call and foreign put, investors preferred the foreign put 25.74% (SE=3.45%) of the time. The difference is not statistically significant.

As presented below, we further divided the observation by ambiguity category (Figure 5), portfolio composition (Figure 6), and conducted various regression analyses (Table 5). However, we did not find any significant result to support our theory.

The two possible explanation for the results we observed are: 1. familiarity and 2. risk hedging. The result we observe here may be due to higher familiarity of foreign companies shown over the US companies. The survey of familiarity of the companies chosen during the portfolio building section was not taken and cannot be tested.

Another possible explanation which we can infer from the data is that the investors were hedging their risk. Since the mean share of US companies in the investor's portfolio is 51%, we can split the investors into two types: US-heavy investors who have over 51% of US companies in their portfolio and US-light investors who have less than 51%. Then, from Figure 6 we observe that among the US-heavy investors, they are much more likely to prefer foreign put over US call ($p < 0.1$). However, this difference disappears when we only consider the US-light investors. Since the investors over-invested in US assets during the portfolio building section, they may have decided to under-invest in company comparison section since these are exactly the same companies they previously invested in. This type of experimental spill-over is a potential drawback of having the same subject participate in the various treatments.

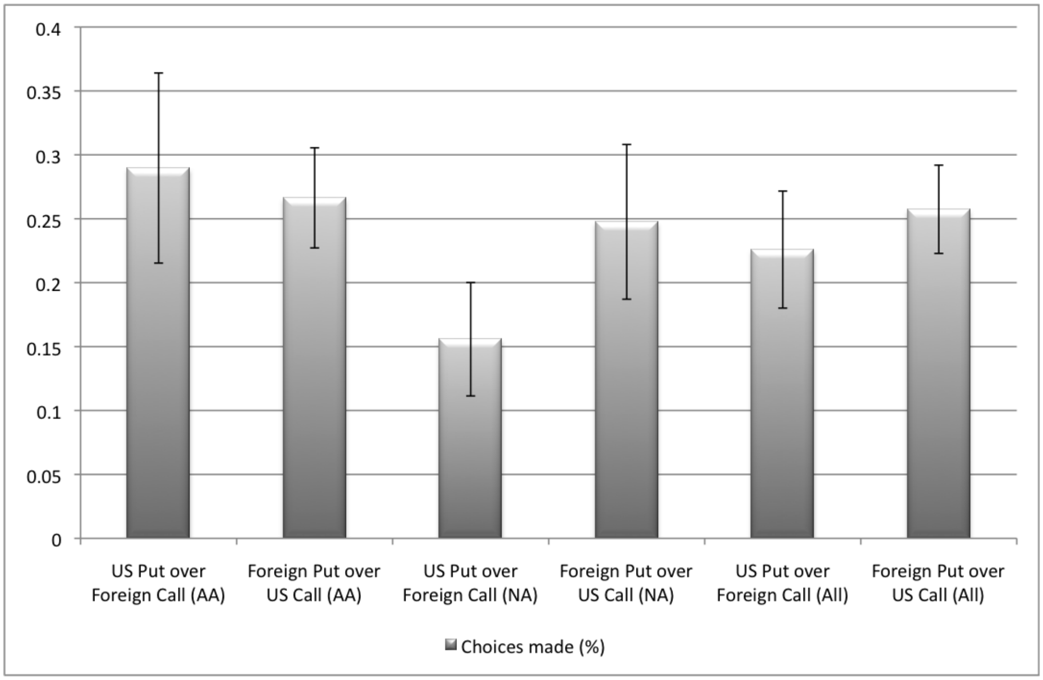


Figure 5: Company Comparison Choices Made: By Ambiguity

AA: Ambiguity Averse. NA: Not Ambiguity Averse

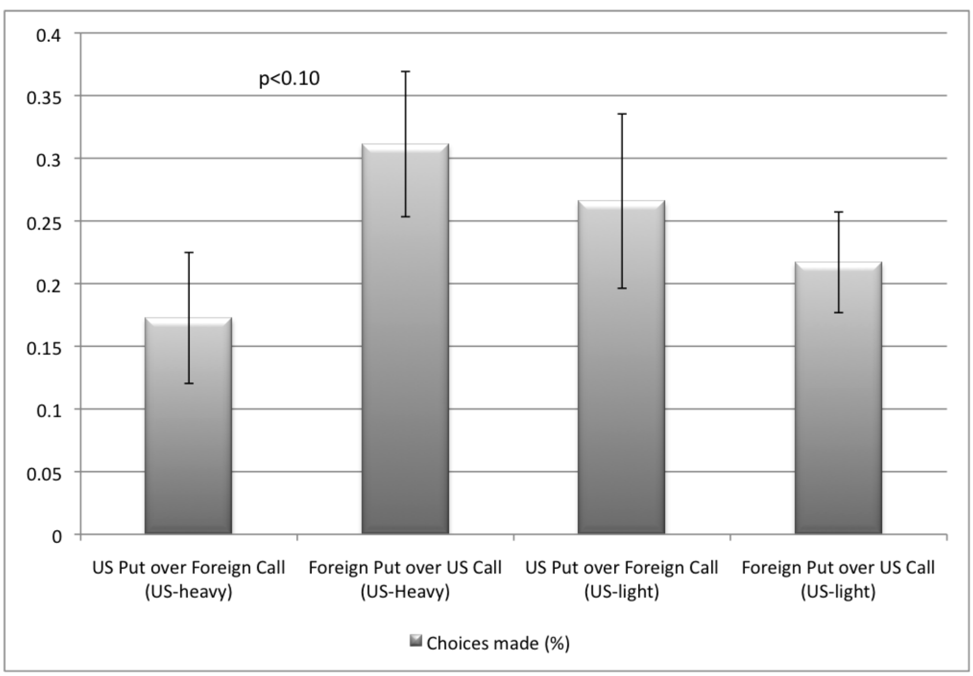


Figure 6: Company Comparison Choices Made: By Portfolio

US-heavy: Portfolio consists of more than 51% US companies. US-light: Portfolio consists of less than 51% US companies

	Dependent Variables	Independent Variable: Constant	Independent Variable: Ambiguity Averse
US-Heavy	US Put over Foreign Call	0.143*	0.067
		(0.077)	(0.109)
	Number of Obs: 9. R^2: 0.0507		
US-Heavy	Foreign Put over US Call	.379***	-0.153
		(0.074)	(0.110)
	Number of Obs: 9. R^2: 0.2157		
US-Light	US Put over Foreign Call	0.169	0.167
		(0.106)	(0.138)
	Number of Obs: 12. R^2: 0.1271		
US-Light	Foreign Put over US Call	0.116**	0.173**
		(0.050)	(0.065)
	Number of Obs: 12. R^2: 0.4125		
*p < 0.1, **p < 0.05, ***p < 0.01. (Two-tailed test) Numbers in parentheses are standard errors.			

Table 5: Regressions: Company Comparison Choices Made

US-heavy: Portfolio consists of more than 51% US companies. US-light: Portfolio consists of less than 51% US companies

8 Experiment 4: Position Holding

Definition 2 *A* ***position*** *is a vector* $\theta = (\theta_1, ..., \theta_n) \in \mathbb{R}^n$*, where* n *is the number of companies available and* θ_i *denotes the number of shares of company* i*.*

Definition 3 *Holding a* ***short*** *position means that the investor has done the following procedure. The investor borrowed the share from another investor and sold it today at today's price. Then the investor will buy back the share in the future and return the borrowed share to the original owner.*

One should short a share if he believes that the stock price will drop in the future. The payoff from short position: $price_{today} - price_{future}$.

Definition 4 *Holding a* ***long*** *position means that the investor has done the following procedure. The investor borrowed cash to buy the stock today at today's price. Then the investor will sell the stock in the future and pay back the borrowed money.*

One should long a share if he believes that the stock price will increase in the future. The payoff long position: $price_{future} - price_{today}$

Example: $\theta = (1, 2, -4, 2)$ with companies $Q =$(Microsoft, Dell, Shell, IBM). The holding from this position is θQ^T which indicates that the investor holds a long position on 1 share of Microsoft, 2 shares of Dell, shorted 4 shares of Shell and holds a long position on 2 shares of IBM.

Definition 5 *The preference relation $\succeq$ satisfies the* ***sure-thing principle*** *if for any subset $E \subset S$, $(x_1, ..., x_S)$, $(x'_1, ..., x'_S)$, $(\overline{x}_1, ..., \overline{x}_S)$ and $(\overline{x'}_1, ..., \overline{x'}_S)$ are such that 1. For all $s \notin E$: $x_s = x'_s$ and $\overline{x}_s = \overline{x'}_s$ and 2. For all $s \in E$: $x_s = \overline{x}_s$ and $x'_s = \overline{x'}_s$ then $(\overline{x}_1, ..., \overline{x}_S) \succeq (\overline{x'}_1, ..., \overline{x'}_S) \iff (x_1, ..., x_S) \succeq (x'_1, ..., x'_S)$.*

8.1 Experimental Summary and Motivation

This experiment provides a method for testing the behavior of the investor in the multiple companies setting. This can be seen as investing in funds (such as mutual funds). In this experiment, the investor was asked to choose between taking a position that is shown or taking a bond. We will first discuss the concept behind this experiment and then discuss the exact implementation in the experimental structure section. This experiment is structured in the following manner. The investor was given a list of domestic positions $\theta_D \neq (0, ...0) \in \mathbb{R}^n$. We then went through several iterations and determined the investor's preference between the position and bond. Then we asked for the investor's preference between $\theta = (\theta_D, \theta_F)$ and a bond, where $\theta_F \in \mathbb{R}^M$ is a position in foreign companies. Again we went through several iterations in this setting. Lastly, we asked for the investor's preference between $\theta^* = (\theta_D, -\theta_F)$ and a bond. For the purpose of payment, an investor was paid from a randomly selected trial and was paid based on the performance of the choice. If a position was selected, investor was paid based on the performance of the position. We capped the earnings at \$10 while the minimum was bounded at \$0 for the purpose of the experiment.

The data allows us to test whether the investor's preferences are consistent. In other words, if the investor preferred θ_D over the bond but preferred the bond over $\theta = (\theta_D, \theta_F)$, then he should prefer $\theta^* = (\theta_D, -\theta_F)$ over the bond. Otherwise, he is violating the *sure-thing principle* (Savage 1954).[9] Same argument applies to the setting in which the investor prefers bond over θ_D, $\theta = (\theta_D, \theta_F)$ over the bond and $\theta^* = (\theta_D, -\theta_F)$ over the bond.

8.2 Experimental Structure

This is divided into two phases. This section is written to provide a detailed explanation of what actually occurred during the experiment and may be skipped. The overview was explained in the previous section.

Phase 1: Single US and Single Foreign Company

1. Randomly select a US company listed under the call option from experiment 1.
   (a) Ask for preference between the positive position of this company and a bond.
   (b) Repeat this procedure until "position" choice is selected.

[9] Note that the violation of the sure-thing principle is a necessary but not a sufficient condition for ambiguity aversion.

2. Randomly select a foreign company.
   (a) Ask for preference between a positive position from the US company from 1-b and negative position from the foreign company.
   (b) Repeat this procedure until the "bond" choice is selected.
3. Reverse the position for the foreign company from 2-b and ask for preference between the bond and the position.

Phase 2: Two US and Two Foreign Companies

1. Randomly select 2 US companies (without replacement) and give one a positive and one a negative position.
   (a) Compare the position with a bond.
   (b) Repeat this 4 times.
2. Randomly select 2 foreign companies (without replacement), give one positive and one negative position, and pair this with one of the pairs from 1 (without replacement).
   (a) Compare the position with a bond.
   (b) Do this for all 4 pairs
3. Reverse the foreign company's position from 2.
   (a) Compare the position with a bond.
   (b) Do this for all 4 pairs

This section addresses the following two major questions: 1. Do investors violate the sure-thing principle in the multiple companies setting? 2. If so, who are more likely to violate the sure-thing principle?

8.3 Results

In this section, each investors provided 5 data points.[10] Each data point is a binary result of whether the investor violated the sure-thing principle. On average, investors violated the sure-thing principle 0.81 times (SE = 0.164), hence violated the sure thing principle approximately 1 out of 5 times. These violations of sure-thing principle supports the argument that investors are ambiguity averse towards foreign assets.

Judging by the regression in Table 6, investors are more likely to violate the sure-thing principle in the position experiment if they are ambiguity averse ($\beta = 4.920$, $p < 0.10$).

[10] This is because a series of choices only provides 1 observation.

This result again supports the theory that ambiguity aversion does play a role in home bias. However, US-heavy investors are less likely to violate the sure-thing principle if they are also ambiguity averse ($\beta = -9.367$, $p < 0.10$), which is consistent with the results from the third experimental design (company comparison).

Dependent Variable: Position (number of times sure-thing principle was violated)				
Ind. Variables	Constant	Ambiguity Averse	US Assets	AmbiguityXUS Assets
	-0.404	4.920*	2.109	-9.367*
	(1.811)	(3.303)	(3.430)	(6.516)
Number of Obs: 21. R^2: 0.1278				
*p < 0.1, **p < 0.05, ***p < 0.01. (One-tailed test)				
Numbers in parentheses are standard errors.				

Table 6: Regression: Violation of Sure-Thing Principle

US Asset: % of US companies in investor's portfolio

9 Experiment 5: Portfolio Building with Indices

9.1 Setup for Indices

Thus far we have focused on individual companies. We will shift our focus to indices for the next two experimental designs. Both setup and the experimental designs for the indices treatment are similar to the setup and the designs for the individual companies. There are several reasons why we need to consider both indices as well as individual companies. First, average investors tend to discuss and invest at a company level for daily trading. However, when the average investors are planning a retirement plan through financial advisors, they tend to invest in indices that are provided by the holding company. Secondly, people are more familiar with the companies than indices. In other words, there is less of a company-level effect or company-level informational advantage, since indices are composed of hundreds of different companies. Therefore, showing ambiguity aversion at the indices level may provide a stronger case of home bias. We are interested to learn whether the ambiguity aversion is concentrated only at the individual company level or if it is also present at the index level.

For the indices treatment, we have selected 25 domestic and 25 foreign major indices defined by Bloomberg[11] which varied in capitalization size as well as industry focus. All the investors were initially provided with a web-based prospectus. The prospectus was created using data provided by Bloomberg which included summarization of the index, value of the index for the past three months and their trading volume. The sample instructions, screen shots, and the list of indices are provided in the appendix.

9.2 Experimental Summary and Motivation

A motivation for this design is to test whether there is home bias in investment behavior when dealing with indices. Investors were shown indices one by one and were asked to build their portfolio. A total of 25 domestic and 25 foreign indices were shown in a random order. For each of the indices, they were given 3 options: buy the index, sell the index, or receive a bond instead. The investors were paid based on the performance of their portfolio 7 days after the experiment was concluded. The payment structure was:

- If bond: \$1.00
- If buy: $\$1.00 + (20 \times r)$
- If sell: $\$1.00 - (20 \times r)$

where r is the return from the index. Although we did not use the term, they were actually going long or short on the indices. The returns were multiplied by a factor of 20 to stimulate long term investment.

[11] www.bloomberg.com

This study answers the following major questions: 1. Is there home bias when investing in indices? 2. Are investors more familiar with US indices? 3. Are people more likely to buy, sell, or receive a bond with US assets? 4. Do ambiguity averse investors have different portfolio composition? Overall, what is the relationship between familiarity, ambiguity aversion, and investment choices?

9.3 Results

First, just as with the individual company treatment, investors are indeed more familiar with the US indices than the foreign indices. When investors were asked to rate the familiarity of each index from 1-6, 1 being least and 6 being most familiar, the average familiarity for US indices was 2.057 ($SE = 0.032$) and for foreign indices was 1.268 ($SE = 0.018$), significantly different at $p < 0.01$. In fact, the correlation of familiarity is stronger for indices ($\rho = 0.364$, $p < 0.01$) than for individual companies ($\rho = 0.24$, $p < 0.01$).

Three random-effects regressions are presented in Table 7 for *Bond*, *Sell* and *Buy* as the functional form in Equation (5):

$$choice_{ij} = \alpha + \beta_1 \text{us index}_j + \beta_2 \text{index familiarity}_{ij} + \beta_3 \text{ambiguity averse}_j \tag{5}$$

where i is the index for the individuals and j is the index for the indices. Bond, Sell and Buy variables take 1 if the investor chose to receive the respective choice, 0 otherwise. US index is a dummy variable taking 1 for an US index. Index familiarity ranged from 1-6 as stated above. The ambiguity averse variable takes 1 if the investor was classified as ambiguity averse via Ellsberg's experiment, 0 otherwise.

The *Bond* regression's significant coefficient is only for the index familiarity ($\beta_2 = -0.029$, $p < 0.1$), which states that investors are more likely to take the bond choice if they are less familiar with the index. This is consistent with findings from the individual company treatment. The *Sell* regression and the *Buy* regressions also have one variable that is statistically significant and it is for dummy variable US Index: $\beta_1 = -0.193$, $p < 0.01$ for *Sell* and $\beta_1 = 0.185$, $p < 0.01$ for *Buy*. This suggests that investors are much more likely to buy a US asset while less likely to sell a US asset. This is consistent with a home biased investor.

Figure 7 and Figure 8 presents the composition of investor's portfolio. Overall, we find that investors are more likely to buy than to receive a bond or sell ($p < 0.01$) although the difference in bond and selling is not significantly different. The biggest contrast appears when comparing US indices to foreign indices. There is no significant differences when comparing the ratio of selling and bond for US indices but investors are much more likely to buy US indices: composed over 50% of the portfolio ($p < 0.01$). However, the investment ratio is more evenly spread out when it comes to foreign indices. There is no significant difference when comparing buying and selling behavior for the US indices. When we divide the observation to high familiarity (familiarity level > 2) to low familiarity (familiarity level ≤ 2, investors are much more likely to choose to buy than to sell or receive a bond with in both categories ($p < 0.01$). Furthermore, investors have higher ratio of bond when it comes to low familiarity indices compared to familiar indices ($p < 0.01$). Lastly, with respect to ambiguity averse to non-ambiguity averse investors, we find that non-ambigity averse investors are much less likely to take the bond option ($p < 0.1$). However, there is no significant difference in the ratio of buying indices, but ambiguity averse investors have higher ratio of selling ($p < 0.05$).

We conclude that investors are: 1. indeed home biased (more buying and less selling in US indices), 2. more familiar with US indices, 3. more likely to buy familiar indices, 4. ambiguity averse individuals are more likely to receive a bond, and 5. more likely to receive a bond when faced with unfamiliar indices.

	Dependent Variable		
Ind. Variables	Bond	Sell	Buy
Constant	0.304***	0.394***	0.303***
	(0.065)	(0.042)	(0.059)
US Index	0.006	-0.193***	0.185***
	(0.034)	(0.036)	(0.038)
Index Familiarity	-0.029*	0.023	0.007
	(0.015)	(0.016)	(0.017)
Ambiguity Averse	0.062	-0.084	0.022
	(0.093)	(0.053)	(0.081)
Overall R^2	0.0095	0.0435	0.0389
Number of Obs: 792. Number of Groups: 16.			
*p < 0.1, **p < 0.05, ***p < 0.01. (Two-tailed test) Numbers in parentheses are standard errors.			

Table 7: Random-Effects Regression: Portfolio Composition with Indices
IV: US: 1 if true, 0 otherwise. Index Familiarity: from 1-6 least to greatest. Ambiguity Averse: 1 if true, 0 otherwise

DV: Bond: chose Bond. Sell: chose Sell. Buy: chose Buy

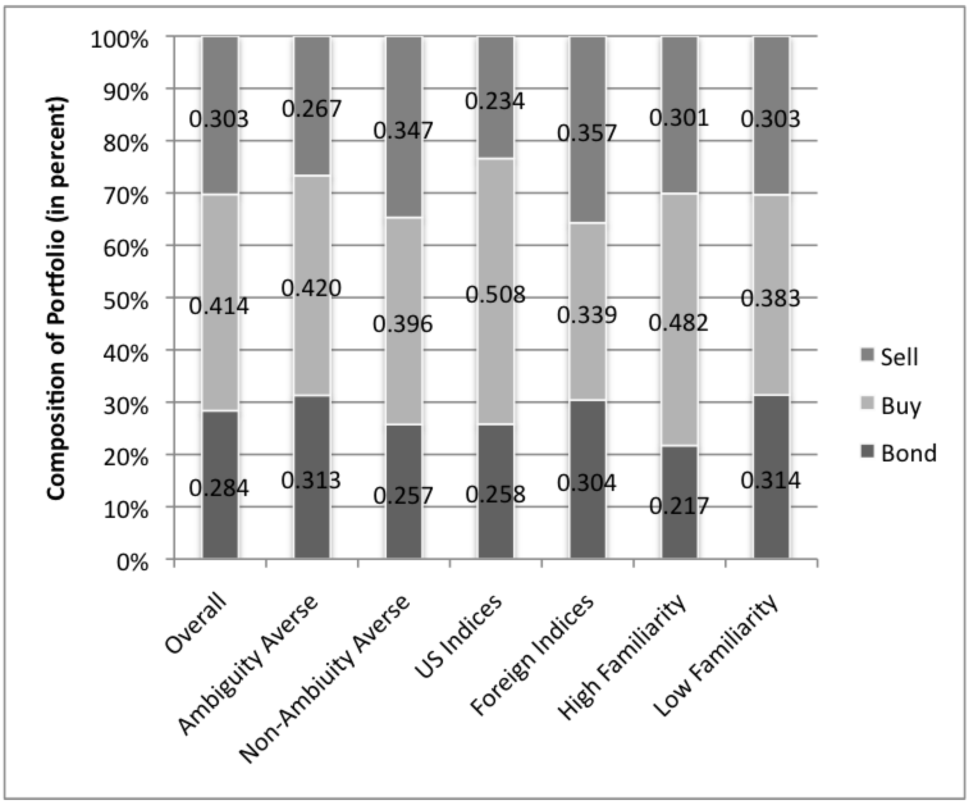


Figure 7: Composition of Portfolio for Indices

Average SE = 0.0178. Maximum SE = 0.0266

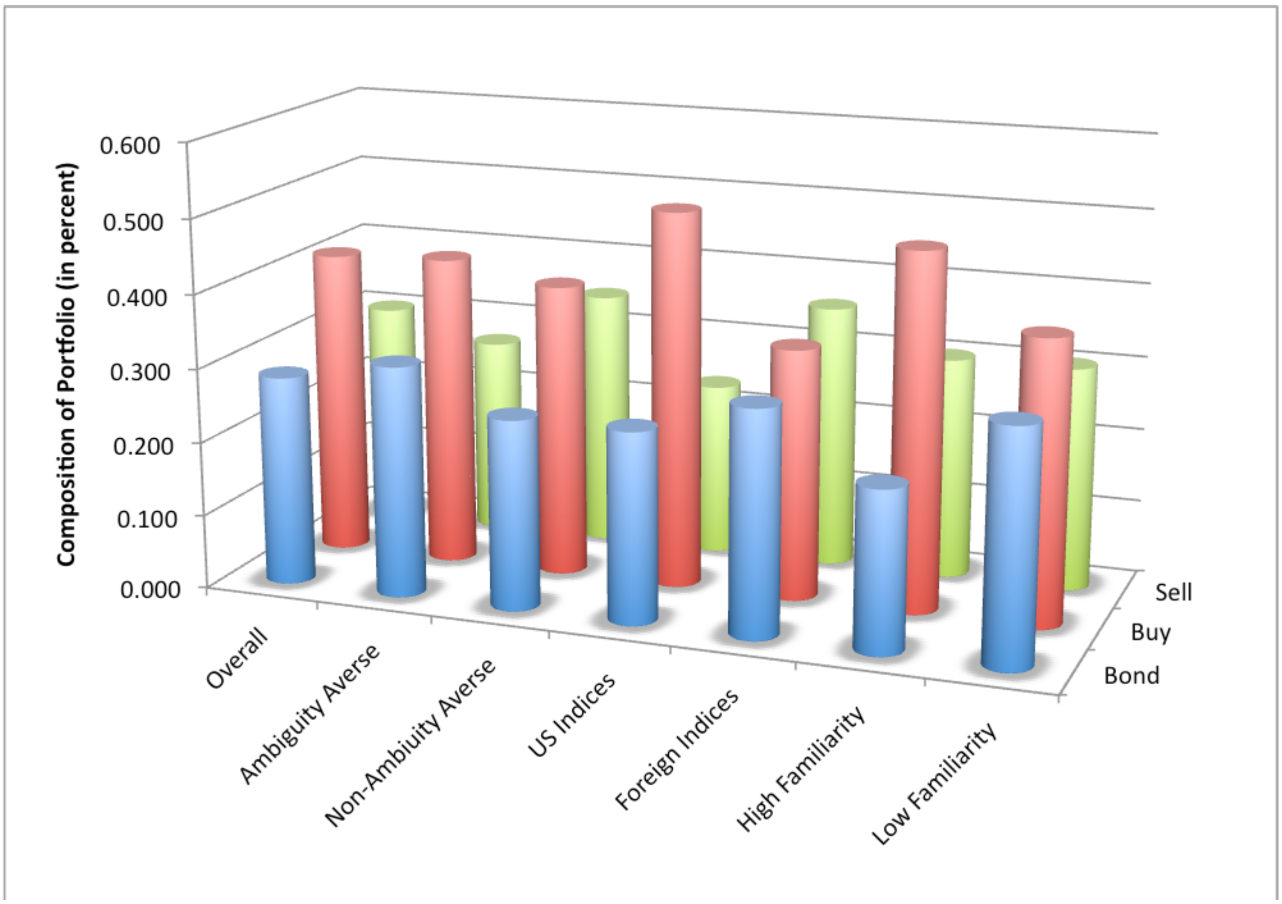


Figure 8: Composition of Portfolio for Indices

Average SE = 0.0178. Maximum SE = 0.0266

10 Experiment 6: Bond or Options with Indices

10.1 Experimental Summary and Motivation

The design for this experiment is similar to the *Bond or Options* experiment under the individual companies treatment. The investors were shown series of indices one at a time and were given three possible choices just as in the stock treatment:

- Receive a bond which pays \$1.00 with probability P.
- Receive a digital call option with exercise value of \$1.00 with probability $1 - P$.
- Receive a digital put option with exercise value of \$1.00 with probability $1 - P$.

However, there are two differences. First, we used indices instead of companies: 25 domestic and 25 foreign, which were presented in random order. Second, we varied the value of P, the known risk of receiving the actual derivative. Instead of focusing only on $P = 33\%$ or $P = 29\%$ as in the individual companies treatment, we varied the $P \in \{30, 32, 34, 36\}$ for the indices treatment. Note that we are in a super-additive subjective probability measure once $P \geq 34\%$.

This study answers the following major questions. What is the relationship between familiarity, ambiguity aversion, and investment choice?

10.2 Results

Table 8 presents several random-effects logistical regression models. We regress sub-additive cases, super-additive cases, and all cases with the following two functional forms:

$$decision_{ij} = \alpha + \beta_1 \text{us index}_j + \beta_2 \text{familiarity}_{ij} + \beta_3 \text{P-level} \tag{6}$$

and

$$decision_{ij} = \alpha + \beta_2 \text{familiarity}_{ij} \tag{7}$$

Table 8 details the dependent variables. Consistent with our findings thus far, we find that people are more likely to take the option with more familiar indices (see model (1), (2), (4), and (5)). The significance disappears once we focus only on the super-additive cases and this is expected (see model (3) and (6) in Table 8). Furthermore, model (1) shows that people are also more likely to take the option with a US index compared to foreign index.

Unlike the case with the individual companies, we do not get a strong result when analyzing the data by ambiguity and origin of indices (see Figure 9). The difference in rate of choosing an option is not statistically different when we divide our observation by US indices only and foreign indices only. Furthermore, even in the aggregate level, the difference is only marginally significant ($\mu_{non-ambiguity\ averse} = 0.89 \neq 0.84 = \mu_{ambiguity\ averse}$, $p < 0.15$, two-tailed t-test).

Figure 10 compares the decisions divided by ambiguity classification of the investors and their familiarity level for the indices. Consistent with the results from the individual companies, we do find that investors are more likely to take the bond (in turn, showing sub-addivity in subjective probability), when it comes to unfamiliar assets compared to non-ambiguity averse investors. This difference, again disappears appropriately when we focus the observation to familiar indices.

In summary, although not as strong as the individual company treatment, we find that subjects show ambiguity aversion when it comes to investing in unfamiliar indices.

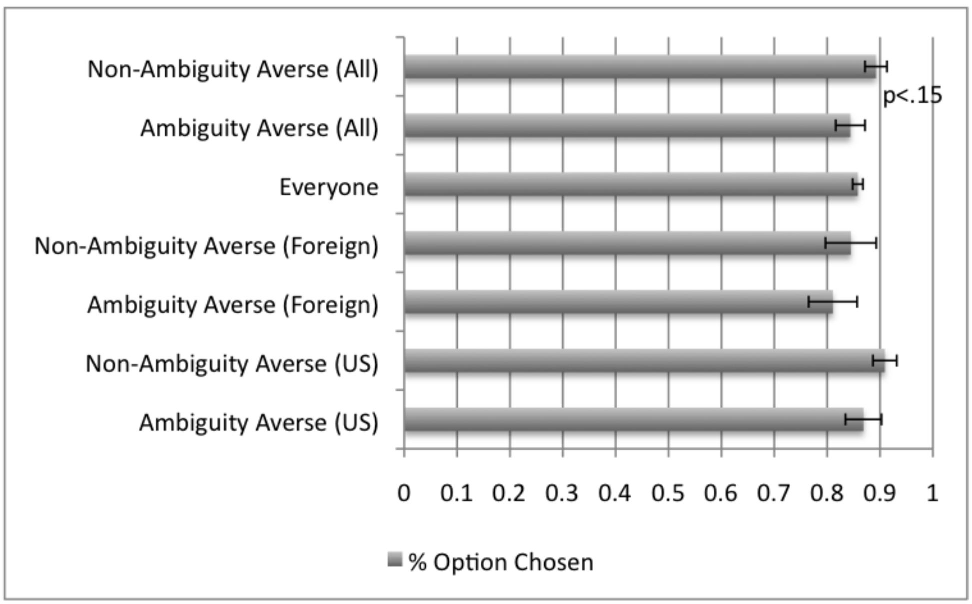


Figure 9: Decision Comparison: By Ambiguity and Origin of Indices

Sub-addivity cases only: $P \in \{30, 32\}$

Dependent Variable: Decision = 1 if Option and 0 if Bond						
Ind. Variables	All P-level (1)	$P \in \{30, 32\}$ (2)	$P \in \{34, 36\}$(3)	All P-level (4)	$P \in \{30, 32\}$(5)	$P \in \{34, 36\}$(6)
Constant	13.045***	4.983	24.582***	1.674 ***	2.225***	0.802*
	(1.734)	(5.110)	(5.074)	(0.295)	(0.262)	(0.488)
US Index	0.277*	0.196	0.405			
	(0.168)	(0.195)	(0.507)			
Familiarity	0.202**	0.171*	0.085	0.355***	0.198**	0.192
	(0.085)	(0.100)	(0.191)	(0.080)	(0.098)	0.164
P-level	-0.348***	-0.089	-0.677***			
	(0.052)	(0.160)	(0.143)			
Log likelihood	-627.066	-420.044	-184.201	-659.718	-420.661	-196.493

All P-level: Number of Obs: 1,692. Number of Groups: 34
$P \in \{30, 32\}$: Number of Obs: 1,296. Number of Groups: 34
$P \in \{34, 36\}$: Number of Obs: 396. Number of Groups: 16

*p < 0.1, **p < 0.05, ***p < 0.01. (Two-tailed test)
Numbers in parentheses are standard errors.

Table 8: Random-Effects Logit Regression: Decision for Indices
IV: US Index: 1 if true, 0 otherwise. Familiarity: from 1-6 least to greatest. P-level: 30, 32, 34, or 36

DV: Restrict sample to their respective variables

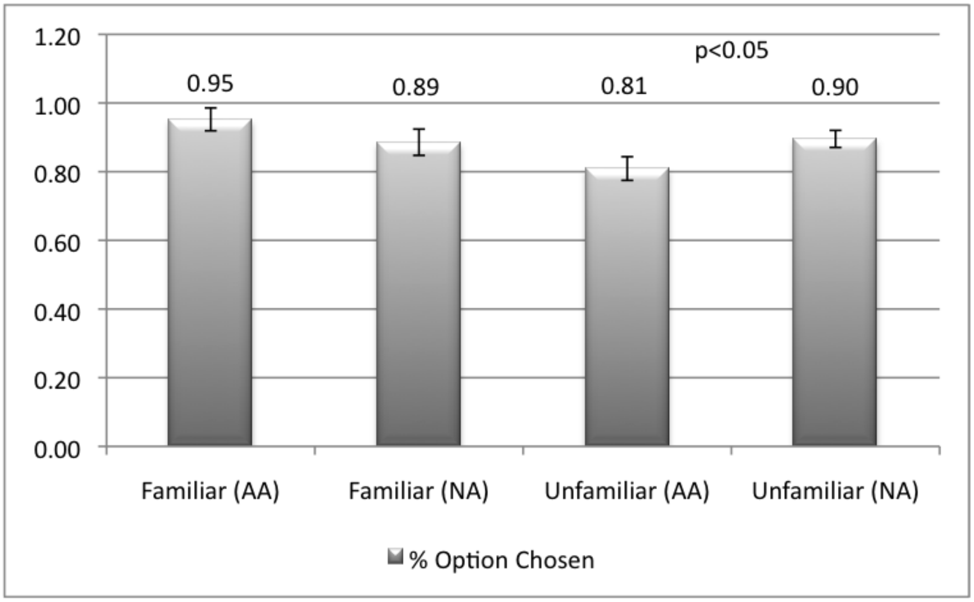


Figure 10: Decision Comparison: By Ambiguity and Familiarity for Indices
AA: Ambiguity Averse. NA: Not Ambiguity Averse

Familiar if familiarity level > 2. Otherwise, Unfamiliar. Sub-addivity cases only: $P \in \{30, 32\}$

11 Conclusion

We started out this research to show that ambiguity aversion is a possible candidate for explaining home bias paradox despite what the rational choice model suggests. We designed experiments that used real world assets and prices. We then used the concept of sub-addivity to show whether an investor's choices expressed ambiguity aversion. Our experimental data supports the theory that ambiguity aversion partly explains home bias phenomena.

Overall, experiment 5 (*Portfolio Building with Indices*) provided the strongest support for home bias in our lab environment and experiment 2 (*Bond or Options* with individual companies) provided the strongest support that ambiguity aversion helps to explain some part of home bias behavior.

In quick summary, we classified about 50% of the participants as ambiguity averse by using the Ellsberg's urn experiment. Portfolio building with individual companies showed a modest size in home bias. Bond or Options with individual companies experiment showed that investors do show higher rate of ambiguity aversion (sub-additivity in probability) when it comes to unfamiliar assets, and the investors are more familiar with US assets. The company preference experiment failed to show significant results which we contribute to spill-over effect from the portfolio building experiment. The position holding experiment demonstrated that investors do violate the sure-thing principle approximately 20% of the time, and ambiguity averse investors are even more likely to violate the principle. Portfolio building with indices provided evidence that there is home bias in our laboratory setting; investors prefer to buy familiar indices and are more familiar with US indices. Lastly, Bond or Options with Indices experiment also showed that, even with indices, investors exhibit higher rate of ambiguity aversion when investing with unfamiliar indices.

Overall, the results provided here show positive support that ambiguity aversion as a partial explanation of home bias phenomenon. As Camerer and Karjalainen (1994) stated, methodologically, "this kind of work is difficult" and that even these modest size (sub-addivity of less than 5%) in ambiguity aversion "could have important economic consequences" (pp. 348 - 349). Therefore, we are quite content with our modest result provided through our experiment, and hopeful for future research.

12 Appendix

12.1 Instructions for Individual Companies

The following 4 pages are sample instructions used in the experiment.

Instruction provided to the students.

These instructions were handed out one section at a time

Experiment Overview

You are about to participate in an experiment in the economics of decision making. If you listen carefully and make good decisions, you could earn a considerable amount of money that will be paid to you in cash or check at the end of the experiment (7 days from today).

You will not be paired with any other individual. In addition, no other person's decision will influence your outcome. All your choices will be recorded today and your outcome will be realized one week from today.

The rules for the experiment are as follows. Do not talk or communicate with other participants. If you are using a computer, do not use any software other than that is explicitly required by the experiment. You are not allowed to browse the internet or check emails, etc. If you are violate these rules, you'll be asked to leave without pay. Feel free to ask questions by raising your hand or signaling to the experimenter.

Payment: You will receive a show-up fee of $10 today. At the end of today's session, you can arrange to either pick up the additional earnings in cash in person at Baxter Hall, Room 6 or have a check mailed to you.

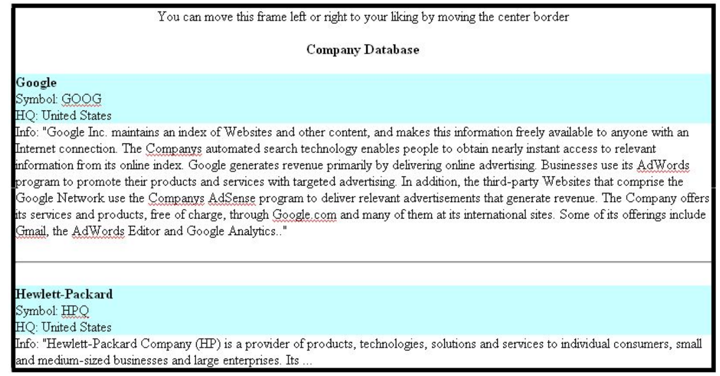
The Process will now be explained in detail.

The Process

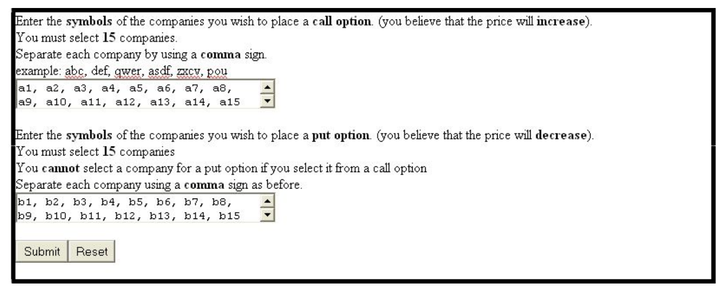
This experiment is divided into four parts plus a survey section.

Part 1. Portfolio Building

In this part of the experiment, you will be shown a list of companies and be asked to build a portfolio. All the companies are from the technology or semiconductor industry and are considered to be one of the top 50 biggest companies in the world with respect to their industry by Forbes. Included in the company list are the company name, company ticker symbol, location of the headquarters and a brief information about the company provided by finance.google.com. In this particular portfolio, you'll be asked to choose **15** companies in which you wish to receive call options and **15** companies in which you wish to receive put options. Details about these options will be explained below. You will receive one call option per company you list under the call option box. You will receive one put option per company you list under the put option box. You cannot use the same company twice (meaning, if you requested a call option on Microsoft, you cannot request a put option on it as well). When inserting the companies, please insert the company **symbol** separated by **comma**. Do **not** place a comma after the last symbol. See screen show below for an example.



Above is the sample of the company list. Below is the sample of portfolio building section.



Options: Put option will give you $0.50 if the stock price of the company one week from today is lower than the stock price today. Call option will give you $0.50 if the stock price of the company one week from today is higher than the stock price today. You will be paid $0.50 regardless of the type of option you hold if the stock price one week from today is the same as today's price. Otherwise, you will receive nothing.

Payoff: You will be paid based on how your entire portfolio performs one week from today.

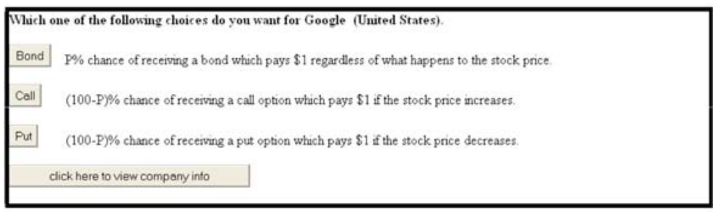
The term "today's stock price" is the last trading price of the company stock collected from finance.yahoo.com and www.tse.or.jp. This price was recorded at noon today (PST). "Price one week from today" is the last trading price of the company stock collected from finance.yahoo.com and www.tse.or.jp 7 days from today, 12:00PM (PST). Please note that finance.yahoo.com has a 10-20 minute delay on the quotes. Hence, at noon, if the last trade posted is 11:45AM, that is the price we will be using. www.tse.or.jp will be used for companies that are not listed with the exchanges from finance.yahoo.com and it also has 10-20 minute delay.

Example: Suppose you are participating on the experiment on Oct 1st. You chose a put option for Google. The last trading price posted on finance.yahoo.com at noon for Google is $400. Seven days from now, Oct 8th, 12:00PM, the last trading price posted on finance.yahoo.com for Google is $401 which is greater than $400. Since you chose a put option, you will not be paid. However, if the last trading price posted on finance.yahoo.com for Google is $400 or below, then you will be able to exercise your option and receive $0.50.

Any questions?

Part 2. Bond or Options?

In this part of the experiment, you will be shown one company name at a time and be asked whether you wish to take the bond (which pays $1), put option or a call option. These options are identical to the options in part 1 and will pay **$1** if exercised. A bond is a risk free asset which will pay you $1 independent of the stock price. In this section, you are also given a button "click here to view company info". Press this button and you will be given the company info for these specific companies. See the screen show below for an example.



Payoff: You will be paid based on the outcome of every trial in this section.

However, in this section, you are not guaranteed to receive a bond or an option. You will be given the **probability** of receiving the choice you select. In the above example, if you choose to receive a bond, you have 33% chance of actually receiving it. If you do receive it, you'll be paid $1 regardless of what happens to the company's stock price. Otherwise, you will receive $0. If you choose to receive a call option, then you have a 67% chance of receiving it and 33% chance of receiving nothing. Note that when you do actually receive a put option, you are not guaranteed to be paid $1 unless the stock price one week from today is less than today's price. See the table below to get a better understanding of the payoff.

If you select a Bond	Today's stock price is less than next week's stock price	Today's stock price is greater than next week's stock price
33% chance	$1	$1
67% chance	$0	$0

If you select a Call option	Today's stock price is less than next week's stock price	Today's stock price is greater than next week's stock price
33% chance	$0	$0
67% chance	$0	$1

If you select a Put option	Today's stock price is less than next week's stock price	Today's stock price is greater than next week's stock price
33% chance	$0	$0
67% chance	$1	$0

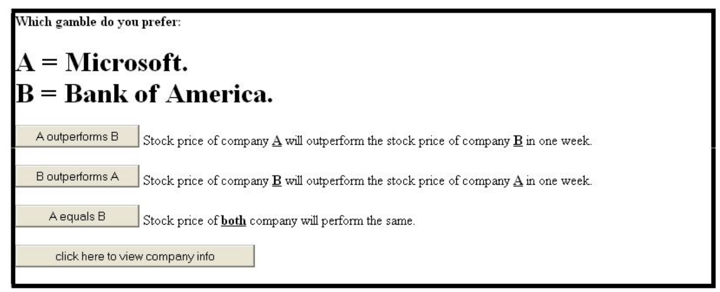
This is how the "chance" is determined in this section. If it states that there is a 45% chance of receiving a bond, it means the following: we will use a random number generator which gives a number from 1 - 100. If the number given is from 1 - 45, you will receive the bond. Otherwise, you will not. Again, if it states that there is a 55% chance of receiving an option, it means the following: we will use a random number generator which give a number from 1 - 100. If the number is from 46 - 100, you will receive the option. Each trials are independent of each other. This means that we will run the random number generator each time for each trial you have in this section.

Any questions?

Part 3. Company Preference

In this part of the experiment, you'll be shown two company names (A and B) and will be given three gambles to choose from (see screen shot below). First choice is a bet that company A will out perform company B in one week from now. Next choice is a bet that company B will outperform company A in one week from now. Last choice is a bet that company A and B will perform the same. You are also given a button "click here to view company info". Press this button and you will be given the company info for these specific companies.

Payoff: Using a random number generator, we will randomly select one of the trials. You will be paid based on the performance of the trial selected: if the gamble you chose is the winner, you will receive $5. Otherwise, you'll receive nothing.



The term "outperform" is defined as follows: company A out performs company B if and only if the increase in percentage of the dollar value of company A's stock price is higher than the percentage increase of the dollar value of company B's stock price. The time in which the stock prices are taken will be the same as in part 1.

Example1 : A = Intel and B = IBM.

	Today's price	Next week's price	Percentage change
A	$100	$101	**1%**
B	$50	$51	**2%**

In the table above, you would have made the correct choice if you chose "B outperforms A".

	Today's price	Next week's price	Percentage change
A	$100	$101	**1%**
B	$50	$49	**- 2%**

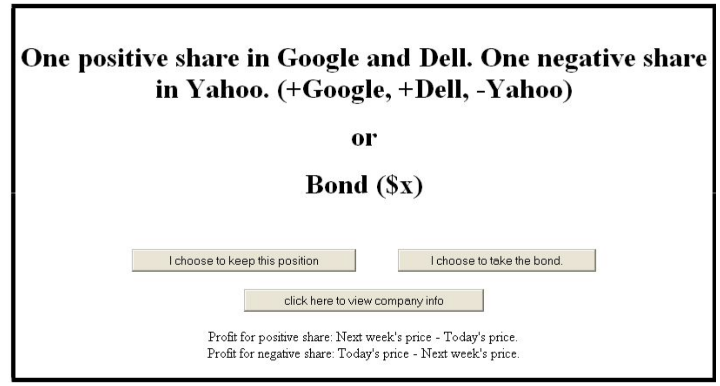
In the table above, you would have made the correct choice if you chose "A outperforms B".

Any questions?

Part 4. Position Holdings.

In this part of the experiment, you will be shown a list of companies and a position held. You will be asked if you prefer to keep the current position or a bond. See screen shot for an example. A position is a portfolio constructed with both positive and negative shares of the company stock. When you have a positive share, it means that you have borrowed money today to buy the stock (at today's price) and will sell it in the future to pay back the loan. Negative share means you have borrowed the stock to sell it today (at today's price) and will buy it back in the future (at the future price) to return the stock to the owner. See example below to see how these will actually work. A bond is a risk free asset, meaning, it will pay $x in one week regardless of the outcome of the position. In this setting, you will only work with one share per company. In summary, you want to have a negative share if you believe that the price will drop and a positive share if you believe that the price will increase. If you believe that the total return from your position is going to be less than $x, when you should choose the bond.

Again, you are also given a button "click here to view company info". Press this button and you will be given the company info for these specific companies.



How to Calculate your payoffs by holding your position:

To calculate your profit with positive share: Next week's price - Today's price = profit.

To calculate your profit with negative share: Today's price - Next week's price = profit.

Payoff: Using a random number generator, we will select one of the trials. In one week, you will be paid based on the performance of the selected position. The Bond will pay $x dollars in one week, regardless of the outcome of the position. $x differs between trial and will be specified accordingly during the trials. Since this is an experiment, you will not have to pay anything back if you end up owing money by holding your position. Therefore, the worse you can do with a position holding is zero which is still strictly less than what you will receive with by holding the bond. In addition, the maximum that a position can pay off will be limited at $10.

The time in which the stock prices are taken will be the same as in part 1.

Example of what a positive share means:

Today: Price of Toyota share is $50.	Next week: Price of Toyota share is $40
Your profit = $40 - $50 = - $10	

Example of what a negative share means:

Today: Price of Toyota share is $50.	Next week: Price of Toyota share is $40
Your profit = $50 - $40 = $10	

Example: (- Microsoft, + Intel, - IBM, + Toyota)

Position	Company	Today's price	Next week's price	Payoff
-	Microsoft	$50	$55	-$5
+	Intel	$40	$41	$1
-	IBM	$100	$50	$50
+	Toyota	$102	$50	-$52

Adding up the results in the payoff column, this position has paid off **-$6**. This will provide you with return of zero. However, if you chose the bond instead, you would have received $x regardless of what happen to the position.

In summary, take the bond if you believe that the sum of the payoff by holding the position is going to be less than $x. Otherwise, take the position.

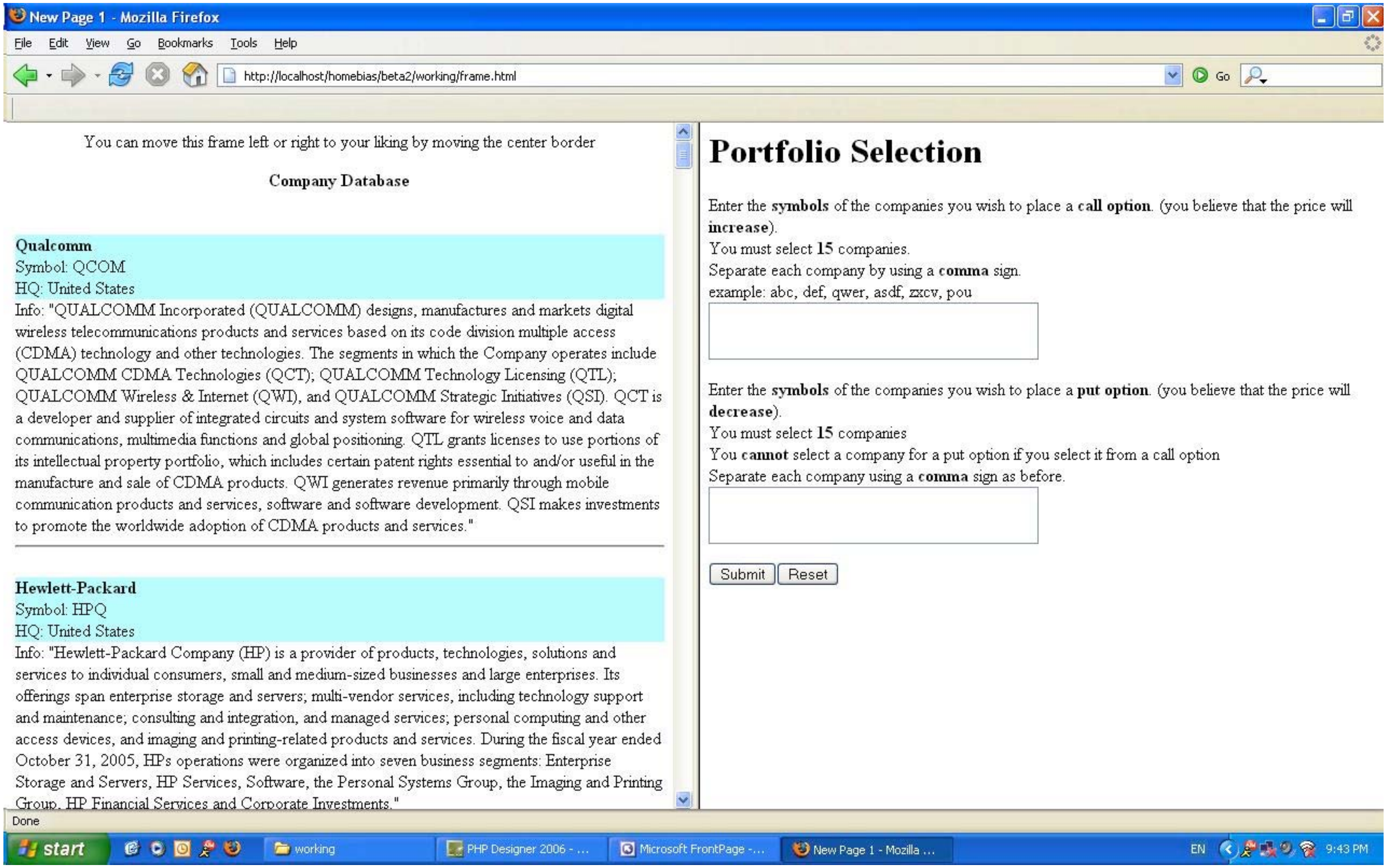
Any questions?

Click here when instructed to do so by the experimenter.

12.2 Screenshot for Individual Companies

The following page is a sample screenshot from the experiment.

Sample Screen Shot



12.3 Instructions for Indices

The following 5 pages are sample instructions and screenshots used in the experiment.

Instructions for the Financial Decision Making Experiment

Welcome to the Financial Decision Making Experiment. So far, you had a chance to look over the prospectus. Now you will be explained the details of the experiment. If you listen carefully and make good decisions, you could earn a considerable amount of money that will be paid to you in cash or check at the end of the experiment (7 days from today).

You will not be paired with any other individual. In addition, no other person's decision will influence your outcome. All your choices will be recorded today and your outcome will be realized one week from today.

The rules for the experiment are as follows. Do not talk or communicate with other participants. If you are using a computer, do not use any software other than that is explicitly required by the experiment. You are not allowed to browse the internet or check emails, etc. If you violate any of these rules, you will be asked to leave without pay. Feel free to ask questions by raising your hand or signaling to the experimenter.

Payment

You will receive a show-up fee of $10 today. You will be told in detail of how you can arrange to pickup the additional earnings at the end of the experiment.

All accounting from here on out are done in a fictitious currency called *Francs*. Exchange rate: 200 francs = 1 USD. At the end of the experiment, all your earnings will be converted back to USD.

The experiment is divided into two parts plus a survey section.

Part 1. Portfolio Building

In this part of the experiment, you will construct your portfolio over a series of rounds. In each round, you will be presented with a stock index. These indices are the indices you had a chance to look over during the prospectus section. Your decisions will be whether you want to buy a share of the index, sell a share of the index or buy a bond. (See example below).

Keys: Press 1 for Buy. Press 2 for Bond. Press 3 for Sell.

Figure 1: Portfolio building example screen

Each index will cost 100 francs. To calculate your payoff from your investments on the indices, we will pay you the original investment plus your percent return multiplied by 20. This is done to increase the range of possible returns and to simulate longer-term investments.

To summarize, the payoffs for the three possible choices are:

Bond: 100

Buy: 100(1+20*r) You buy if you want to bet that the index value will increase.

Sell: 100(1-20*r) You sell if you want to bet that the index value will decrease.

For example, suppose you invested in XYZ Index at 50. One week later, XYZ is at 52. We will calculate the % return as (52 - 50) / 50 = 0.04. Your initial investment of 1 share of XYZ will then be worth 1 + (20 * 0.04) = 1.8 times as much, or 180 francs.

If you buy the bond, you will be paid a fixed sum of 100 francs.

One More Example

To make sure you understand the payoffs, we will now go through an example showing all the possible outcomes.

Suppose that there are three rounds. You are asked to invest in Indices ABC, OPQ, and XYZ. You choose to buy ABC, sell OPQ, and took the bond on XYZ. Suppose one week from now, ABC gained 5%, OPQ gains 3%, and XYZ loses 10%.

Your return would then be $1+(20\times 0.05)=2$ for ABC (you bought ABC and it gained), $1+(20\times -0.03)=0.4$ for OPQ (you bought OPQ and it lost), and 1 for XYZ (you took the bond).

Finally, because everything costs 100 francs, you will make 100(2 + 0.4 + 1) = 340 francs. Table 1 summarizes the above.

	ABC	*OPQ*	*XYZ*
Your choice	Buy	Sell	Bond
Initial investment	100f	100f	100f
Outcome	+5%	+3%	-10%
Your return (20x)	100%	-60%	0%
Your payoff	200f	40f	100f

Table 1: Sample payoff table

Thus, your total payment for Part I will be the aggregate return from your entire portfolio.

The term "today's value" is the last trading price of the index collected from finance.yahoo.com and Bloomberg. This price was recorded at noon today (PST). "Value one week from today" is the last trading price of the index collected from the same websites 7 days from today, 12:00PM (PST). Please note that these websites have a 10-20 minute delay on the quotes. Hence, at noon, if the last trade posted is 11:45AM, that is the price we will be using. Bloomberg will be used for companies that are not listed with the exchanges from finance.yahoo.com and it also has 10-20 minute delay.

Any questions?

Part 2: Bond or Options?

In this part of the experiment, you will be shown one index at a time and be asked whether you wish to receive, with some probability, a bond (which pays 300 Francs), a digital put option or a digital call option.

Digital Options:

- *Digital put option* pays 300 francs if the index value one week from today is lower than the index value today, 0 otherwise. (You buy a put if you want to bet that the price will decrease).

- *Digital call option* pays 300 francs if the index value one week from today is higher than the index value today, 0 otherwise. (You buy a call if you want to bet that the price will increase).

Bond:

- *Bond* is a risk-free asset that pays 300 francs regardless of what happens to the value of the index.

The choice that you will have to make in this portion of the experiment is shown in the example screen below.

Keys: Press 1 for Bond, 2 for Up and 3 for Down.

Figure 2: Digital options example screen

As you can see, you are not guaranteed to receive a bond or an option. You will be given the **probability** of receiving the choice you select.

In the above example, if you choose to receive a bond, you have 30% chance of actually receiving it. If you do receive it, you will be paid 100 francs regardless of what happens to the value of the index. Otherwise, you will receive 0 francs.

	Today's Index value is less than next week's Index Value	Today's Index value is greater than next week's index value
30% chance	300 Francs	300 Francs
70% chance	0	0

Table 2: Payoff structure for the Bond

If you choose to receive a put option, then you have a 70% chance of receiving the option and 30% chance of receiving nothing. Note that when you do actually receive a put option, you are not guaranteed to be paid 100 francs unless the Index value one week from today is less than the value today. See the table below to get a better understanding of the payoff.

	Today's Index value is less than next week's Index Value	Today's Index value is greater than next week's index value
30% chance	0	0
70% chance	0	300 francs

Table 3: Payoff structure for the Put option

If you select a Put option	Today's Index value is less than next week's Index Value	Today's Index value is greater than next week's index value
30% chance	0	0
70% chance	300 francs	0

Table 4: Payoff structure for the Call option

This is how the "chance" is determined in this section. If it states that there is a 30% chance of receiving a bond, it means the following: we will use a random number generator which gives a number from 1 - 100. If the number given is between 1 to 30 (inclusive), you will receive the bond. Otherwise, you will not. Again, if it states that there is a 70% chance of receiving an option, it means the following: we will use a random number generator which gives a number from 1 - 100. If the number is between 31 to 100 (inclusive), you will receive the option. Each of the trials is independent of each other. This means that we will run the random number generator each time for each trial you have in this section.

Payment: Your total payment from part 2 will be based on the outcome of every trial in this section.

Financial Decision Making Experiment

California Institute of Technology

Introduction

Welcome to the Financial Decision Making Experiment website's Prospectus section. This prospectus contains information about the investment decisions that you will make during the actual experiment.

You are not required to memorize information from this prospectus, but familiarity with the materials in it can help you make more informed investment decisions.

To the left of you is a window with list of major stock indices throughout the world sorted alphabetically.

A stock market index is a listing of stocks and a statistic reflecting the composite value of its components. Most indices pertain to a specific country; the underlying stocks generally bear some commonality such as trading on the same stock market exchange, belonging to the same industry, or having similar market capitalizations.

Navigate the Prospectus

The prospectus is divided into two frames. The frame on the left of the screen contains a list of the major stock indices throughout the world in alphabetical order. For each of the indices, the index's country of origin is listed in the prentices.

To find out more detailed information about the index, click on its name. The information will appear in the current frame.

Example:

X
XYZ Index (Country)

Detailed Indices Information

Each index is divided into 3 sections. First section will provide you with the name, symbol and the country origin for the index. The number of stocks in the index is also included in a prentices unless it already is a part of the name of the index (example: S&P 100).

Next, you will be provided with a graph of the historical prices and trading volume of the index for the past 3 months (Mid May until end of July).

Lastly, you'll be provided with a brief description of the index itself.

Example:

Name: Name of the Index (Number of companies included in this index)

Symbol: Symbol of the Index

Country: Country where the index represents

The upper portion of the graph represents the historical performance. It's vertical axis depicts the value.

The bottom portion represents the Volume (number of trades that occurred for the underlying companies) as a bar graph.

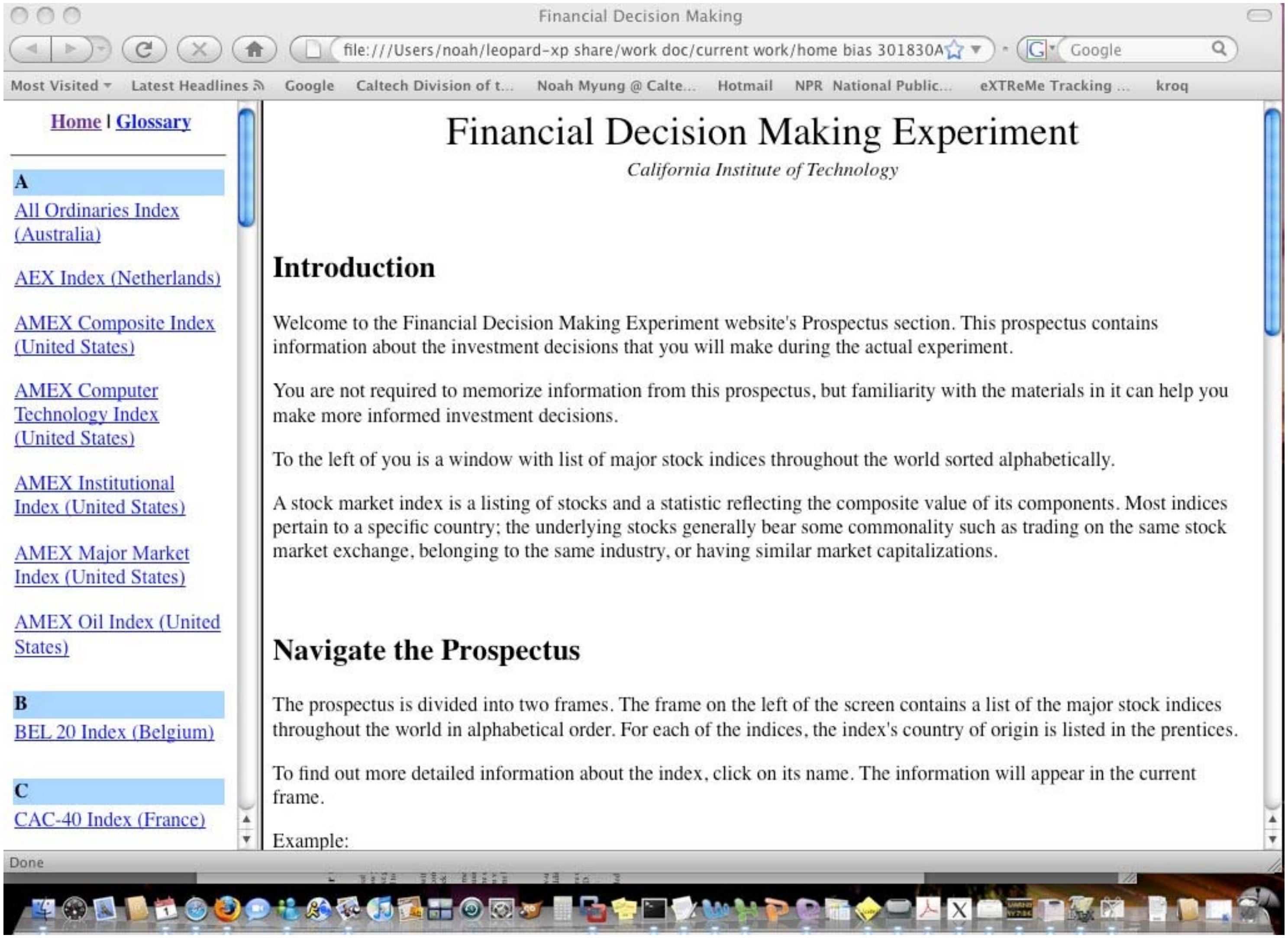
For both portion of the graph, the horizontal axis represents time, starting from mid-May 2006 until end of July 2006.

The XYZ index, derived from country ABC is a stock market index composed of Technology companies that trade on ABC exchange market. It is a capitalization-weighted index that consists of the 25 largest funds that trade on the exchange.

Glossary

Some of the references in this prospectus may be unfamiliar to you. We have included a glossary of terms that is intended to aid you in comprehension. The *glossary* link at the top of the left frame will take you to the glossary.

To return to the current page, click on the *home* link at the top of the menu.


Financial Decision Making
file:///Users/noah/leopard-xp share/work doc/current work/home bias 301830A
Google
Most Visited
Latest Headlines
Google
Caltech Division of t...
Noah Myung @ Calte...
Hotmail
NPR National Public...
eXTReMe Tracking ...
kroq
Home | Glossary
A
All Ordinaries Index (Australia)
AEX Index (Netherlands)
AMEX Composite Index (United States)
AMEX Computer Technology Index (United States)
AMEX Institutional Index (United States)
AMEX Major Market Index (United States)
AMEX Oil Index (United States)
B
BEL 20 Index (Belgium)
C
CAC-40 Index (France)
Financial Decision Making Experiment
California Institute of Technology
Introduction
Welcome to the Financial Decision Making Experiment website's Prospectus section. This prospectus contains information about the investment decisions that you will make during the actual experiment.
You are not required to memorize information from this prospectus, but familiarity with the materials in it can help you make more informed investment decisions.
To the left of you is a window with list of major stock indices throughout the world sorted alphabetically.
A stock market index is a listing of stocks and a statistic reflecting the composite value of its components. Most indices pertain to a specific country; the underlying stocks generally bear some commonality such as trading on the same stock market exchange, belonging to the same industry, or having similar market capitalizations.
Navigate the Prospectus
The prospectus is divided into two frames. The frame on the left of the screen contains a list of the major stock indices throughout the world in alphabetical order. For each of the indices, the index's country of origin is listed in the prentices.
To find out more detailed information about the index, click on its name. The information will appear in the current frame.
Example:
Done

References

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