Investment Preference Biases on Mutual Funds: A Conjoint Analysis on Employees of Taiwan's Financial Institutions

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Abstract

This study focuses on mutual fund investment preference, combining mutual fund type, channels, and way of subscription, for employees of financial institutions. We use fractional factorial design and clustering on demographics and form two diversified groups according to the conjoint analysis with interactive consideration. The result reveals that women with longer working years prefer fixed period investment in fixed income funds via bank. By contrast, younger men with shorter working years prefer single investment in equity funds via bank and security firms. In addition, monthly investment for younger men is significantly higher than that for women. Gender bias owing to varied personal demographics exists in individual investment. The correspondence analysis for cross-validation enhances the conclusion from the hypothesis.

Keywords: Clustering Method, Conjoint Analysis, Correspondence Analysis, Fractional Factorial Design, Multivariate Nonparametric Statistics, Mutual Fund Investment Biases

JEL Classifications: C12, C13, C14, C18, D14, D81, D91

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1. Introduction

A mutual fund is an investment vehicle that pools money from investors to invest in financial markets. The investment preference of employees of financial institutions for mutual funds is noteworthy. Understanding people's preference to invest in the type of mutual fund and the amount and frequency of allocation form the basis of our discussion. Furthermore, we explore the impact of personal demographics on mutual fund investment preference.

Scholars have studied investor behavior on stock investment. Here, to explore their investment selection biases, we provide a viewpoint on mutual fund investment selection behavior with Taiwan financial institution employees, who could have more in-time information than ordinary people. We perform fractional factorial design with designed questionnaire issues and collect data from employees working in Taiwan's financial institutions. The authors determine that a new analytical approach can be applied and adapted with new metrics for data collection, stimulus construction, response judgment scales, and estimation procedures. We apply the full factorial design with sophisticated factors to marketing data. When dealing with a small unbalanced sample, the fractional factorial design results in an interactive effect for mutual fund investment preference, detecting the confounding effect between the selected factors. Compared with the full factorial design used in previous studies, the fractional factorial design seems suitable on a small unbalanced sample with interactive effects.

Behavioral finance is a loss-based thought in terms of difference, whereas traditional finance is a risk-based model. Kahneman and Tversky (1979) indicate losses having a more significant emotional impact than a game when facing investment. We apply the same logic to the mutual fund investment behavior of Taiwan financial institution employees who may have more advanced information than others. Furthermore, the bias in investment choices reveals the differences in terms of demographic background. We may stereotype that informers are not naïve trend chasers but are more responsive to their investment selection process than demographic factors. This study highlights that investors considerably emphasize attributes other than mutual fund risk and return. Tzang, *et al.* (2021) illustrate information asymmetry between individual and institutional investors in the stock market. Our study group is those working in the Taiwan's financial institutions who have information well ahead of ordinary individual investors and can make investment adjustments before ordinary people. However, from the study, we have found their investment behavioral biases from their investment preference. It shows that even for people with information, judgment has a role in their final investment decision.

The remainder of this study is as follows. Section 2 provides a brief literature review of behavioral finance biases and mutual fund investment preference. Section 3 describes the data

and research methodology. Section 4 summarizes the empirical results and discussion. Finally, Section 5 gives the concluding remarks.

2. Literature Review

2.1. Evolution of Mutual Fund Investment Behavior

This study employs conjoint analysis to design a questionnaire to evaluate the perception of financial institution employees in Taiwan. In marketing research, Green and Srinivasan (1978) first propose conjoint analysis, a method jointly considering multiple factors, as a tool for consumer preference research. Cattin and Wittink (1982) and Wittink and Cattin (1989) observe the survey results concerning the commercial use of conjoint analysis between 1970 and 1985.

Marketing experts have questioned the predictive accuracy of full factorial design in conjoint analysis because confounding factors in the model can result in some measurement problems. Interactive confounding effects have a more significant impact, attributable to the full factorial design in conjoint analysis using balanced data with orthogonal factor loadings. Furthermore, the association between choice and preference seems vague without constraints as the part-worth value performs on each respondent. Accordingly, we use selective constraints with preference recognition for better responses. Incorporating similar respondents for their choice predictions, clustering could strengthen the predictive power in conjoint analysis (Hagerty, 1985). Moreover, clustering can help detect proper preferences with alternative segmentation methods. To reshape the preference that segmentation methods explore, the accuracy of estimation increases through clustering segment with the part-worth or utility measure of conjoint analysis.

Numerous design combinations correspond to varied mutual fund preference characteristics. The orthogonal design reveals a better preference ranking for different attributes and factor levels. Kuhfeld, *et al.* (1994) indicate that the efficiency of conjoint analysis depends on the coding of statistical analysis, considering non-orthogonality in effect. With appropriate constraints for our goals, the fractional factorial design indicates a better distinction in the preference of different factors. With clustering segmentation, the fractional factorial design offers merit with a few preferences and unbalanced respondents at hand in each segment, considering interactive effects between factors. This approach enriches our understanding of the preferences concerning mutual fund investment decisions with appropriate constraints in the design. Jiang, *et al.* (2020) indicate that mutual fund financial literacy has a more significant impact on investment outcomes in China. Mahdzan, *et al.* (2020) indicate that risk tolerance plays a minor role in the survey, but business and economic education help mutual fund investment in Malaysia. Capon, *et al.* (1996) consider performing variables for the decision-making process on mutual fund investment. The authors reveal that different variables, other than risk and return, determine mutual fund investment strategies. Pompian and Longo (2004)

consider these variables as psychological attributes for investors and explored their study from investor behavior. In our study, we consider people working in the Taiwan's financial corporates. Equipped with a sophisticated measuring tool, the problem in the study follows a similar footprint; however, a conjoint analysis explores the mutual fund selection preference of some clustering investors.

Confining our research respondents to the person who works in a financial institution considers man or woman an informed investor. Using questionnaires to investigate the preference for informed respondents provides precise responses and makes preference ordering easier to reveal. It could be considered an expert system application in which conjoint analysis combines with fractional factorial design on informed respondents. Reibstein, *et al.* (1988) argue that the type of data collection process impacts the reliability of the conjoint analysis under varied constraints imposed. The reliability increases when the data collection process forms an expert system in which informed people provide their viewpoints on specific questions we design. For the ordinal or nominal scales, a nonparametric method is an effective tool for analysis. We perform nonparametric robustness tests on these informed respondents when facing a small mutual fund investment preference sample with an ordinal measure.

2.2. Behavioral Finance Biases and Mutual Fund Investment Preference

In modern finance theory, mutual fund selection relies on investors' belief regarding the future return and risk of the assets and covariance of returns with other financial assets (Markowitz, 1959). By focusing on return and risk, the decision-making process narrows down. Mutual fund investors have cognitive and emotional biases in the selection process. It is because of varied information sources, which create different selection criteria from actual data. Investors' perceptions concerning mutual funds result in selective biases concerning their decision on fund selection. Behavioral finance biases considerably impact investment preference. Newall and Parker (2019) use experiments to debias that mutual fund investors prefer past performance rather than fee structure and find specific choice architecture interventions that can remedy their irrational preference. Wang (2014) compares the investment preference of respondents with varied demographic backgrounds to indicate their emotional and cognitive biases in stock investment. People define preference as a way of selecting something over another or others and bias as a preference or an inclination, particularly one that inhibits impartial judgment. It is an unfair act or policy stemming from prejudice. Our study is notable because we observe biases in the investment choice of informed workers in Taiwan. The conjoint analysis explores mutual fund investment and fund allocation preferences of employees of the financial industry in Taiwan.

Barber, *et al.* (2016) indicate that more sophisticated investors evaluate fund performance with more sophisticated benchmarks. Miller (1956) and Wright (1975) claim that people face difficulty processing more than a few pieces of information when making selection decisions.

It is similar to the stereotype of a Narrow Framer. Bailey, *et al.* (2011) suggest that biased investors have stereotypes characterized as Gambler, Smart, Overconfident, Narrow Framer, and Mature. We find many stereotypes for our financial informer on mutual fund investment concerning demographics in the study. Overconfidence and loss aversion are stereotypes. The new drivers of the selection process on mutual funds provide different behavioral perspectives. Our respondents from financial industry practitioners well know the daily changes in the financial market. Even with a limited budget and time constraints, people may believe that employees of Taiwan's financial institutions should have fewer behavioral finance biases than ordinary people. This perception type does not have a ground in the study. We observe several stereotypes concerning mutual fund investment preference in terms of demographic factors. These stereotypes are preference biases when exploring those with appropriate measures.

Mutual funds investment is a different conduit from stock. People consider it is a portfolio investment and is ideal for people with time and energy constraints. Based on the different characteristics of mutual fund and stock investments, behavioral finance bias should differ. Barber, *et al.* (2005) examine the mutual fund investment behavior at U.S. discount brokers for six years. The authors reveal mutual fund investment preference with performance. Results indicate representative heuristic bias, framing effect, and disposition effect on mutual fund trading. The preference here is a perception of mutual fund performance that considerably impacts mutual fund investment decisions. Ramasamy and Yeung (2003) use fractional factorial designed conjoint analysis without clustering exploration to demonstrate the heterogeneity of study groups. The authors identify several factors among financial advisors to have mutual fund selection in Malaysia. Charoenrook and Pavabutr (2017) identify the Thailand mutual fund industry features with their unique survey data. They find that most registered funds in Thailand are fixed-income because of regulation. Bajracharya and Mathema (2017) indicate that most investors in India have some doubts about investing in mutual funds and prefer bank deposits. Gandhi and Joshi (2018) indicate that income increasing plays a role with equity-based mutual fund investment and customer's perception and preference have a relationship with their mutual fund investment decision. In our study, we do not have many restrictions as Malaysia or Thailand. Mutual fund providers have less regulation in Taiwan, and customers hold a larger share of mutual funds issued by international fund houses.

Regarding asset allocation, Bodie and Crane (1997) reveal that the proportion people hold in equities declines with age but rises with wealth. This phenomenon exists in equity and fixed income funds' selection, similar to behavioral biases in mutual fund selection. People with longer working years periodically prefer to invest in a fixed-income fund, and people with shorter working years prefer to invest a lump sum in an equity fund. The wealth effect is difficult to distinguish if people with longer working years have more wealth in which they

choose to invest more in an equity fund. This phenomenon could be attributed to the endowment bias because investors are reluctant to take more risk when they own more wealth.

Behavioral finance is a loss-based thought in terms of difference, whereas traditional finance is a risk-based one with two factors, expected return and volatility. The loss-based thought prevails when people with longer working years have more income but invest less in an equity fund. By contrast, people with shorter working years invest a large portion of income in equity funds via bank. Inspired by Bendixen (1996), we adopt correspondence analysis to indicate the preferences of selected groups as cross-validation. Correspondence analysis indicates that diverse backgrounds, a source of heterogeneity, have distinct mutual fund investment preferences and selection.

3. Data and Research Methodology

3.1. Data Description

The Taiwan's banking and finance industry, excluding insurance firms, practitioners with mutual fund investment experience are the participants of this study. The scope is the monetary, equity, and fixed income mutual funds sold in the bank, security company, or fund house. We conduct a questionnaire survey on financial industry staff members in the Taipei metropolitan area. Accordingly, 99 effective responses were received through purposive sampling on February 15 and June 30, 2014, for empirical analysis.

Following Green and Srinivasan (1978), the questionnaire design in our study uses the part-worth utility model to indicate personal preferences. Table 1 indicates three fund types (factor A), three subscription channels (factor B), and two ways of subscription (factor C), creating 18 combinations from the three profile factors. This study utilizes the fractional factorial design to avoid the difficulty of many combinations. Table 1 indicates nine elements in the combination, forming an orthogonal array. We ask respondents to fill their preference orders from the combination and use the preference orders to explore their investment preferences.

Table 1: A list of the overall profile of the measured targets

preference order	**the combination number**	**The description of the investment characteristics of the measured target**		
		fund type (A)	**subscription channel (B)**	**way of subscription (C)**
□	1	money market【0】	security firm【2】	single investment【0】
□	2	fixed income【2】	fund house【1】	single investment【0】
□	3	money market【0】	bank【0】	single investment【0】
□	4	equity market【1】	bank【0】	single investment【0】
□	5	equity market【1】	fund house【1】	single investment【0】
□	6	money market【0】	fund house【1】	regularly fixed investment【1】
□	7	equity market【1】	security firm【2】	regularly fixed investment【1】
□	8	fixed income【2】	security firm【2】	single investment【0】
□	9	fixed income【2】	bank【0】	regularly fixed investment【1】

Note: 1.Factor level 0, 1and 2 for fund types are money market fund, equity fund and fixed-income fund, respectively.

2.Factor level 0, 1and 2 for subscription channels are bank, fund house, and securities firm, respectively.

3.Factor level 0 and 1 for the ways of investment are single investment and regularly fixed investment.

4.The number in the bracelet【】represents the corresponding level of selected.

The questionnaire includes gender, age, marital status, working years, the level of economic burden, and the number of monthly investments. The economic burden level implies the number of family members raised by the respondent.

According to the three-dimensional cross-table in Table 2, 99 effective samples are diverse in age, gender, and working years. These samples satisfy our requirement that (1) the working years should not be too short while the worker is above 35 years old and (2) the working years should not be too long while the worker is below 35 years old. The classification criterion is based on the researcher's experience, providing a helpful inference and further study implications.

Table 2: The three-dimensional crosstabs of gender, age and working years

gender	Age	working years		
		below 9	9 to 13	over 13
male	under 35	18	15	5
	35 and above	1	11	18
female	under 35	14	3	1
	35 and above	5	4	4

3.2. Analytical Method

Based on the assumption, a difference exists in mutual fund preference ordering among financial personnel with different backgrounds. We conduct different analytics approaches to detect these preferences, segmented people with different types and conclude their investing preference according to their investment characteristics. In the process, we apply conjoint analysis to identify respondents' preference order with each factor combination. Using the hierarchical clustering analysis, we explore the characteristics of respondents and segment their investing preferences in terms of fund types, subscription channels, and ways of subscription. Furthermore, we perform the Kruskal–Wallis test (Kruskal & Wallis, 1952) and Kendall's W test (Kendall, 1955) with the multivariate nonparametric joint confidence interval to reveal the preference of each respondent group. Then, we apply single-dimension correspondence analysis to validate that preference characteristics among people with distinct backgrounds differ. In addition, single-dimensional correspondence analysis identifies distinct characteristics of investment amounts by respondents with varied backgrounds. The analysis indicates distinct group preferences on the coordinate axis.

In the conjoint analysis, modulus three calculates the level $Z_1 + Z_2$ of interaction between fund types and subscription channels (in the notation of AxB). Z_1 denotes the level of investment categories and Z_2 the level of channels. Table 3 expands the orthogonal array for the conjoint analysis with interactions.

Table 3: Orthogonal Arrays with interactive effect

combination	type (A)	channel (B)	way (C)	A × B
1	money market 【0】	security firm 【2】	single 【0】	money market × security firm 【2】
2	fixed income 【2】	fund house 【1】	single 【0】	fixed income × fund house 【0】
3	money market 【0】	bank 【0】	single 【0】	money market × bank 【0】
4	equity market 【1】	bank 【0】	single 【0】	equity market × bank 【1】
5	equity market 【1】	fund house 【1】	single 【0】	equity market × fund house 【2】
6	money market 【0】	fund house 【1】	fixed period 【1】	money market × fund house 【1】
7	equity market 【1】	security firm 【2】	fixed period 【1】	equity market × security frim 【0】
8	fixed income 【2】	security firm 【2】	single 【0】	fixed income × security firm 【1】
9	fixed income 【2】	bank 【0】	fixed period 【1】	fixed income × bank 【2】

Note: The number in the bracelet【】 represents the corresponding level of selected factors (or interactive effect)

Let $a_i(i=0,1,2)$, $b_j(j=0,1,2)$, $c_k(k=0,1)$, and $ab_l(l=0,1,2)$ represent each respondent's selection of fund type at the *i*-th level, subscription channel at the *j*-th level, way of subscription at the *k*-th level, and the interactive effect between type and channel, $A\times B$, at the *l*-th level in their part-worth utility, respectively. Let r_m represent the respondents' preference order to the *m*-th combination. For the convenience of explanation, transform r_m into the total part-worth utility $Y_m = 10 - r_m (m = 1,2,3,....,9)$, indicating the higher the value, the higher the preference. Next, using a model of multivariate analysis of variance (MANOVA), $Y = X\beta + \varepsilon$ to indicate the multivariate linear regression between the total part-worth utility and each level of three primary and one interactive factor. In the model, the vector of total part-worth utility $Y_{9x1}^{'} = [Y_1, Y_2, Y_3, ..., Y_9]$ is with the designed error vector $\varepsilon_{9x1}^{'} = [\varepsilon_1, \varepsilon_2, ..., \varepsilon_9]$

satisfying the assumption of $E(\varepsilon_i)=0$ and $Var(\varepsilon_i)=\sigma^2$, where ε_i is the mutually independent. The parameter set $\beta_{8x1}^{'}=[\mu,a_0,a_1,b_0,b_1,c_0,ab_0,ab_1]$ satisfies the given constraints $\sum_{i=0}^{2}a_i=0$, $\sum_{j=0}^{2}b_j=0$, $\sum_{k=0}^{1}c_k=0$, and $\sum_{l=0}^{2}ab_l=0$, where μ represents the total average part-worth utility of the specified nine combinations in Table 3.

The design matrix shows as

$$X_{9\times 8}=\begin{bmatrix} 1 & X_{1\_a0} & X_{1\_a1} & X_{1\_b0} & X_{1\_b1} & X_{1\_c0} & X_{1\_ab0} & X_{1\_ab1} \\ 1 & X_{2\_a0} & X_{2\_a1} & X_{2\_b0} & X_{2\_b1} & X_{2\_c0} & X_{2\_ab0} & X_{2\_ab1} \\ 1 & X_{3\_a0} & X_{3\_a1} & X_{3\_b0} & X_{3\_b1} & X_{3\_c0} & X_{3\_ab0} & X_{3\_ab1} \\ 1 & X_{4\_a0} & X_{4\_a1} & X_{4\_b0} & X_{4\_b1} & X_{4\_c0} & X_{4\_ab0} & X_{4\_ab1} \\ 1 & X_{5\_a0} & X_{5\_a1} & X_{5\_b0} & X_{5\_b1} & X_{5\_c0} & X_{5\_ab0} & X_{5\_ab1} \\ 1 & X_{6\_a0} & X_{6\_a1} & X_{6\_b0} & X_{6\_b1} & X_{6\_c0} & X_{6\_ab0} & X_{6\_ab1} \\ 1 & X_{7\_a0} & X_{7\_a1} & X_{7\_b0} & X_{7\_b1} & X_{7\_c0} & X_{7\_ab0} & X_{7\_ab1} \\ 1 & X_{8\_a0} & X_{8\_a1} & X_{8\_b0} & X_{8\_b1} & X_{8\_c0} & X_{8\_ab0} & X_{8\_ab1} \\ 1 & X_{9\_a0} & X_{9\_a1} & X_{9\_b0} & X_{9\_b1} & X_{9\_c0} & X_{9\_ab0} & X_{9\_ab1} \end{bmatrix}, \text{where}$$

$$X_{i\_a0}/X_{i\_a1}=\begin{cases} 1/0 & \text{if the level i of factor A is 0} \\ 0/1 & \text{if the level i of factor A is 1} \\ -1 & \text{if the level i of factor A is 2} \end{cases},$$

$$X_{j\_b0}/X_{j\_b1}=\begin{cases} 1/0 & \text{if the level j of factor B is 0} \\ 0/1 & \text{if the level j of factor B is 1} \\ -1 & \text{if the level j of factor B is 2} \end{cases},$$

$$X_{k\_c0}=\begin{cases} 1 & \text{if the level k of factor C is 0} \\ -1 & \text{if the level k of factor C is 1} \end{cases},$$

$$X_{l\_ab0}/X_{l\_ab1}=\begin{cases} 1/0 & \text{if the level l of interactive factor AxB is 0} \\ 0/1 & \text{if the level l of interactive factor AxB is 1} \\ -1 & \text{if the level l of interactive factor AxB is 2} \end{cases}. \quad (1)$$

To meet the general restrictions of $X_{i\_a0}+X_{i\_a1}+X_{i\_a2}=0$, $X_{i\_b0}+X_{i\_b1}+X_{i\_b2}=0$, $X_{i\_c0}+X_{i\_c1}=0$ and $X_{i\_ab0}+X_{i\_ab1}+X_{i\_ab2}=0$, we have the corresponding design matrix from the orthogonal cross-table

$$X_{9\times 8}=\begin{bmatrix} 1 & 1 & 0 & -1 & -1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 0 & 1 & 1 & 1 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 & 1 & 1 & -1 & -1 \\ 1 & 1 & 0 & 0 & 1 & -1 & 0 & 1 \\ 1 & 0 & 1 & -1 & -1 & -1 & 1 & 0 \\ 1 & -1 & -1 & -1 & -1 & 1 & 0 & 1 \\ 1 & -1 & -1 & 1 & 0 & -1 & -1 & -1 \end{bmatrix}. \tag{2}$$

As the model setting, we have $E(Y)=X\beta$, and the moment estimator $\hat{\beta}$ is with $\hat{\beta}=(X'X)^{-1}X'Y$ due to the fact where $rank(X)=8$ and $X'X$ is nonsingular. Thus, we further have

$$\hat{\beta}=\begin{bmatrix} \hat{\mu} \\ \hat{a}_0 \\ \hat{a}_1 \\ \hat{b}_0 \\ \hat{b}_1 \\ \hat{c}_0 \\ \hat{ab}_0 \\ \hat{ab}_1 \end{bmatrix}=\begin{bmatrix} \frac{(Y_1+Y_2+Y_3+Y_4+Y_5+Y_8)+2(Y_6+Y_7+Y_9)}{12} \\ \frac{2(Y_1+Y_3+Y_6)-(Y_2+Y_4+Y_5+Y_7+Y_8+Y_9)}{9} \\ \frac{2(Y_4+Y_5+Y_7)-(Y_1+Y_2+Y_3+Y_6+Y_8+Y_9)}{9} \\ \frac{2(Y_3+Y_4+Y_9)-(Y_1+Y_2+Y_5+Y_6+Y_7+Y_8)}{9} \\ \frac{2(Y_2+Y_5+Y_6)-(Y_1+Y_3+Y_4+Y_7+Y_8+Y_9)}{9} \\ \frac{(Y_1+Y_2+Y_3+Y_4+Y_5+Y_8)-2(Y_6+Y_7+Y_9)}{12} \\ \frac{2(Y_2+Y_3+Y_7)-(Y_1+Y_4+Y_5+Y_6+Y_8+Y_9)}{9} \\ \frac{2(Y_4+Y_6+Y_8)-(Y_1+Y_2+Y_3+Y_5+Y_7+Y_9)}{9} \end{bmatrix}. \tag{3}$$

The fitness of MANOVA bases on the preference order combination with preference order fitted value $\hat{r}$ and observed value r. The thumb rule with the rank correlation coefficient of Kendall's τ is above 0.9. We assess the fitted value $\hat{r}$ as follows. First, we obtain the fitted value of $\hat{Y}$, the total part-worth utility estimate for each combination, from the regression $\hat{Y}=X\hat{\beta}$. Second, we assess $\hat{r}_i$ based on the order of $\hat{Y}_i$; the more prominent $\hat{Y}_i$, the smaller $\hat{r}_i$ to predict the popularity of the *i*-th combination. For the group preference, we average the respective parameter estimate of each respondent to obtain the group parameter estimate vector $\hat{\beta}_g$. Then, we obtain the fitted part-worth utility for each group $\hat{Y}_g$, where $\hat{Y}_g=X\hat{\beta}_g$. After that, we assess the group preference order on the *i*-th combination based on the result order of $\hat{Y}_{ig}$, that is, the larger $\hat{Y}_{ig}$, the smaller $\hat{r}_{ig}$.

Because of the same scale of part-worth utility estimate, if the MANOVA model is appropriate, we obtain the relative important scores for each single and interactive factor as

$$\left(\frac{the\_total\_deviation\_of\_specified\_factor's\_part-worth\_utility}{the\_sum\_of\_total\_deviation\_of\_all\_factors'\_part-worth\_utility}\right)*100. \quad (4)$$

We reject the hypothesis from the joint confidence interval of nonparametric statistics. The average absolute deviation $\left|\overline{R}_{.i}-\overline{R}_{.j}\right|$ is larger than the critical value $\Delta = z(\alpha/2g)[r(r+1)/6n]^{0.5}$. Here, $g = r(r-1)/2$ denotes the pairwise comparison with average important *r* factors, and *n* denotes the number of respondents. This measure determines the significant difference in two factors under the significant level α. If $\left|\overline{R}_{.i}-\overline{R}_{.j}\right| > \Delta$, then the difference between μ_i and μ_j is significant.

Furthermore, if $(\overline{R}_{.i}-\overline{R}_{.j}) > 0$, then $\mu_i > \mu_j$ otherwise $\mu_i < \mu_j$. In our study, by setting the significant level $\alpha = 0.05$ and $r = 4$, it gives $\Delta = 2.638*(10/3n)^{0.5}$. We use the nonparametric joint confidence interval owing to the heterogeneous classification of the selected characteristics, such as fund category, subscription channel, and way of subscription, to help evaluate the impact.

4. Results and Discussion

4.1. Informed Respondent Background

The following is the respondent information. First, the frequency table provides the respondents' background profile, including gender, age, marital status, working years, the level of economic burden, and the amount of monthly investment. Second, Table 4 indicates that the ratio of men to women is 3:7 and that approximately 93% of people are aged 25–45 years. The number of married people (63%) is higher than that of unmarried people. Approximately 33% of respondents have working years between 9 and 13 years. Family members raise no more than two people is approximately 85%. The percentage of the self-financing burden at zero is around a quarter. Furthermore, 47.5% of people invested no more than NT$10,000[1], and 31.3% invested between NT$10,000 and NT$20,000.

In the research on investor behavior, the combination indicator of a customer profile is more beneficial to indicate the different facets than individual background variables. Using the hierarchical cluster analysis on gender, age, marital status, and working years, we divide the selected sample into two segment groups to indicate distinct differences in investor behavior. Accordingly, there are 72 people in the first group and 27 people in the second group. The first segment group includes women with longer working years, and the second segment group comprises younger men aged below 35 years and working years less than nine years.

[1] New Taiwan Dollar, the Taiwanese currency, is abbreviated as "NT$."

Table 4: The information of respondents' background

Variables	**Items**	**All**		**group 1 (female with longer working years)**		**group 2 (male with shorter working years)**	
		freq.	**%**	**freq.**	**%**	**freq.**	**%**
gender	Female	68	68.7	61	84.7	7	25.9
	Male	31	31.3	11	15.3	20	74.1
age	below 35	56	56.6	35	48.6	21	77.8
	35- below 45	36	36.4	30	41.7	6	22.2
	45 and above	7	7.1	7	9.7	—	—
marital Status	Single	37	37.4	28	38.9	9	33.3
	Married	62	62.6	44	61.1	18	66.7
working years	below 3 years	5	5.1	—	—	5	18.5
	3 to 6 (under)	18	18.2	4	5.6	14	51.9
	6 to 9 (under)	15	15.2	10	13.9	5	18.5
	9 to 13 (under)	33	33.3	30	41.7	3	11.1
	13 to 15 (under)	11	11.1	11	15.3	—	—
	15 to 18 (under)	10	10.1	10	13.9	—	—
	18 to 21 (under)	5	5.1	5	6.9	—	—
	above 21	2	2.0	2	2.8	—	—
financial burden	0	27	27.3	17	**23.6**	10	37.0
	1	23	23.2	19	26.4	4	14.8
	2	34	34.3	24	33.3	10	**37.0**
	3 and above	15	15.2	12	16.7	3	11.1
The amount of monthly investment (in NTD)	below 10K	47	47.5	39	54.2	8	29.6
	between 10K and 20K	31	31.3	22	30.6	9	33.3
	between 20K and 30K	11	11.1	6	8.3	5	18.5
	between 30K and 40K	3	3.0	3	4.2	—	—
	between 40K and 50K	3	3.0	—	—	3	11.1
	Above 50K	4	4.0	2	2.8	2	7.4

Note: This notation "—" indicates no number.

We perform the chi-square estimate for the two segmented background groups to indicate the difference between samples using the farthest neighbor method in the unsupervised hierarchical clustering learning. The chi-square test indicates that the segmented two groups

significantly differ in gender, age, working years, and the number of investments,[2] but not on marriage status.[3]

Next, we perform a one-dimensional correspondence analysis to reexamine the relation between investment and the segmented background groups, as indicated in Table 5.

Table 5: Cross-table of segmented background groups and amounts of investment

Background	**Amount (NTD)**		
	below 10K	**between 10K and 20K**	**above 20K**
g1 (group 1)	39	22	11
g2 (group 2)	8	9	10

Figure 1 is a graphical representation in which the statistics are under the specification of chi-square distance measurement—the removal of column and row averages for standardization and symmetric normalizations. The positive pole in the figure denotes an investment amount less than NT$10,000, and the negative pole denotes an investment amount more enormous than NT$20,000 on the coordinate axis. The positive and negative scores of background groups I and II indicate that background group I invests less than NT$10,000 and group II invests more than NT$20,000. In addition, the dimension scores for background group II are significantly higher, indicating the tendency to invest more than NT$20,000.

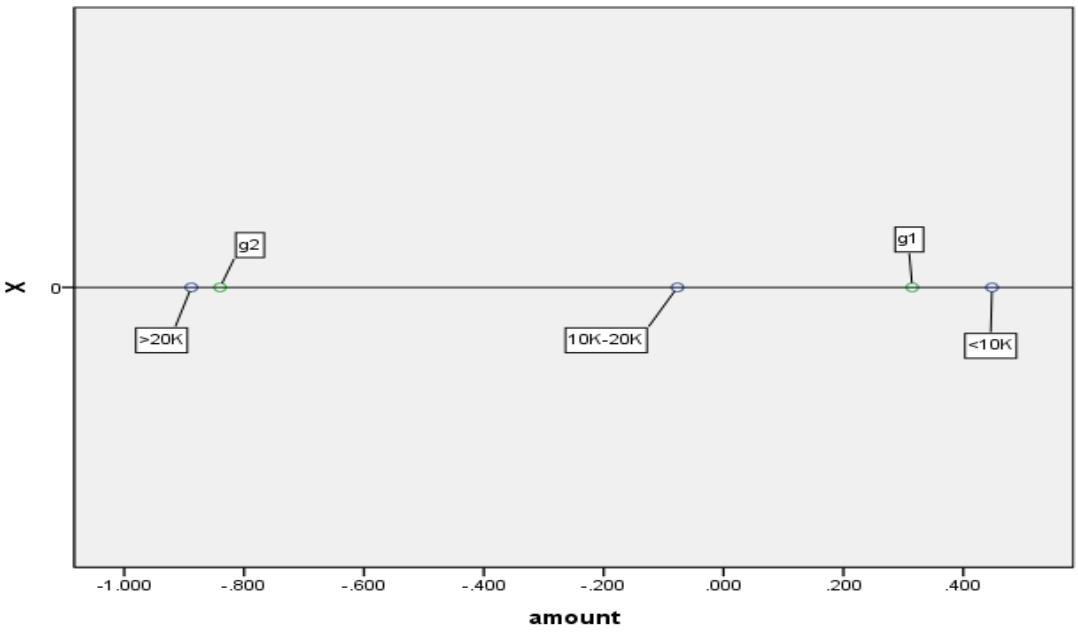

Figure 1: The plot of the background group for the investment amount coordinate

[2] Test statistics = 31.6, 6.8, 7.3, 40.7, and 6.9, respectively; *P* = .000, .009, .007, .000, and .031, respectively.

[3] Test statistics = 0.259; *P* = .611.

4.2. Mutual Fund Investment Preference in Overall and Segmented Groups

We use conjoint analysis on respondents with diverse backgrounds for each level of fund category, subscription channels, and ways of subscription to obtain part-worth utility and essential value. The Kendall's τ correlation coefficients between the fitted order of selective preference and the observed order on overall and segmented groups are above 0.9. This result suggests that the MANOVA model with interactive effect is appropriate for inferring mutual fund investment selection of employees of Taiwan's financial institutions.

The fund category is an essential factor for overall and two-segmented background groups. The substantial value of fund categories in the segmented background group II is well above the subscription channels and ways. The critical value of each factor in the segmented background group I is almost identical, indicating that the three factors are essential. Furthermore, the interactive effect between the fund category and the subscription channels is slightly more important in the segmented background group I than in background group II. For both groups, the choice of fund category is related to one of the subscriptions. In other words, staff members in Taiwan's financial institutions consider the choice of fund categories and the way of channels together.

Regarding part-worth utility value, the two segmented background groups consider the equity market fund in the fund category, bank in the subscription channels, and fixed period investment as necessary. The part-worth utility value in our study indicates that the staff members in Taiwan's financial institutions prefer to invest in the equity fund at a fixed period through the bank channel. In the segmented background group I, the part-worth utility of fixed income investment in the fund category is positive, indicating a preference for fixed income fund investment.

Table 6: The part-worth utility and important value in each level of interesting factors

Factors	Levels	Overall (99)		group 1 (Female with longer working years) (72)		group 2 (Male with shorter working years) (27)	
		part-worth utility	important value	part-worth utility	important value	part-worth utility	important value
Fund type	money market【0】	-0.5544	37.6	-0.4336	30.3	-0.8765	46.6
	equity market【1】	0.6914		0.4182		1.4198	
	fixed income【2】	-0.1369		0.0154		-0.5432	
subscription channels	bank【0】	0.6106	28.9	0.5478	30.9	0.7778	29.3
	fund house【1】	-0.3457		-0.2253		-0.6667	
	security firm【2】	-0.2649		-0.3225		-0.1111	
ways of subscription	single【0】	-0.4276	25.8	-0.4282	30.4	-0.4259	17.3
	fixed period【1】	0.4276		0.4282		0.4259	
fund type × subscription channels	【0】	0.0819	7.6	0.0664	8.4	0.1235	6.8
	【1】	0.0853		0.0849		0.0864	
	【2】	-0.1672		-0.1512		-0.2099	
Constant		5.1448		5.1458		5.1420	

As the fitted preference order in Table 7, the overall group prefers combination four, that is, to invest equity funds at a bank in a single lump sum investment. In background group I, people prefer combination nine, periodically investing in fixed income fund at a bank, and combination four, investing equity fund at a large sum. In the background group II, people prefer combination four and combination seven, periodically investing in equity funds at fund house.

In behavioral finance on stock investment, men are willing to take more risks than females, and older individuals are more risk-averse than are younger individuals. In the study, women with longer working years are more risk-averse than younger men, indicating that working experience influences preference. In Taiwan, people can obtain a better discount when they invest in mutual funds through a fund issuer's security firm. Furthermore, cost consideration is also a factor determining selection. Table 6 indicates that cost is essential when selecting the investment channel. People can have more fund choices when investing through a bank compared with other channels. Thus, both segmented groups prefer to use the bank for equity fund investing in Tables 6 and 7.

Table 7: The preference order fitted value of investment type

The preference combination of investor				**The fitted preference order of target groups**		
The number	Fund category	Subscription Channel	Way of subscription	Overall (99)	group 1 (72)	group 2 (27)
1	money market	security firm	single investment	9	9	9
2	fixed income	fund house	single investment	8	7	8
3	money market	Bank	single investment	5	5	5
4	equity market	Bank	single investment	1	2	1.5
5	Equity market	fund house	single investment	4	6	4
6	money market	fund house	fixed period investment	6	4	7
7	equity market	security firm	fixed period investment	2	3	1.5
8	fixed income	security firm	single investment	7	8	6
9	fixed income	Bank	fixed period investment	3	1	3
The correlation between the fitted order and the observation order						
Pearson's R statistics				0.983	0.967	0.996
Kendall's tau statistics				0.944	0.889	0.986

With the results from Table 6 and 7, we further explore the difference in preference biases between the two segmented background groups. The behavioral finance bias from the study indicates that men are willing to take more risks in their investment preference. The background group II chooses banks considering diverse mutual fund selections. The background group I considers channeling to be more critical because it believes trading cost and general information acquired as essential factors.

4.3. Validation for the Hypothesis

In Table 8, the hierarchical clustering method applies to overall respondents to three distinct groups with preference characteristics from their important values of different factors. The segmentation process, measured by the Euclidean squared metric with Ward's minimum variance method, combines similar samples into a group based on their characteristics.

The Kruskal–Wallis and Kendall's W tests confirm the preference characteristics of each group. The Kruskal–Wallis test compares the critical score of a particular factor among the different groups, whereas the Kendall's W test compares the essential scores of the different factors.

The Kruskal–Wallis test is significant for the difference among the three preference groups, regardless of each attribute factor, from the critical score of attribute factors shown in Table 8. The multiple comparison results in the last row of the table indicate that the first, second, and third preference groups have significantly higher essential scores in the type, channel, and way, respectively. The Kendall's W test is significant for each preference group to indicate different impacts of each attribute factor. In addition, the multiple comparison results for each preference group, in the right column of Table 8, indicate that the attribute factors with the highest significant essential scores in the first, second, and third preference groups are the types, channels, and ways, respectively. Kendall's W test results and the Kruskal–Wallis test have the same statistical significance, reconfirming the finding.

Table 8: Three groups of the preference attribute

the group	**the number of samples**	**percentage**	**type**	**channel**	**way**	**type* channel**	**the Kendall's W test** (W/χ^2)	**p-value**	**multiple comparisons for the Kendall's W test**
1	39	39.4	0.614	0.173	0.090	0.009	.89/104	≈ 0	I W C T
2	41	41.4	0.241	0.551	0.087	0.009	.91/112	≈ 0	I W T C
3	19	19.2	0.269	0.172	0.432	0.043	.85/48.6	≈ 0	I C T W
Overall	99	100	0.393	0.329	0.154	0.016	.67/197	≈ 0	I W C T
Kruskal Wallis test Statistics			70.6	69.1	45.7	45.3			
p-value			≈ 0	≈ 0	≈ 0	≈ 0			
multiple comparisons for the Kruskal Wallis test			231	132	213	123			

Note: In multiple comparisons for Kendall's W test, T、C、W and I represents the fund types、the subscription channels、the ways of subscription and the interactive effect between the fund types and the subscription channels, respectively.

We further apply the single-dimension correspondence analysis in cross-table 9 to revalidate the hypothesis that the preference characteristics among people with different backgrounds differ. Figure 2 is a graphical representation of the statistical measures obtained under the model specification of chi-square distance, with the removal of column and row averages standardization and symmetric normalizations. In the figure, the positive pole represents the type-oriented, and the negative pole represents the channel-oriented. Since background group I and II scores are negative and positive, background group I is inclined to

be channel-oriented, and background group II is type-oriented. In addition, the dimension scores for background group II are significantly higher; the statistical measure reveals that background group II has a stronger preference to be type-oriented.

Table 9. The cross-table of segmented background groups and preference characteristics

Background	**Preference**		
	type	**channel**	**way**
g1 (group 1)	23	34	15
g2 (group 2)	16	7	4

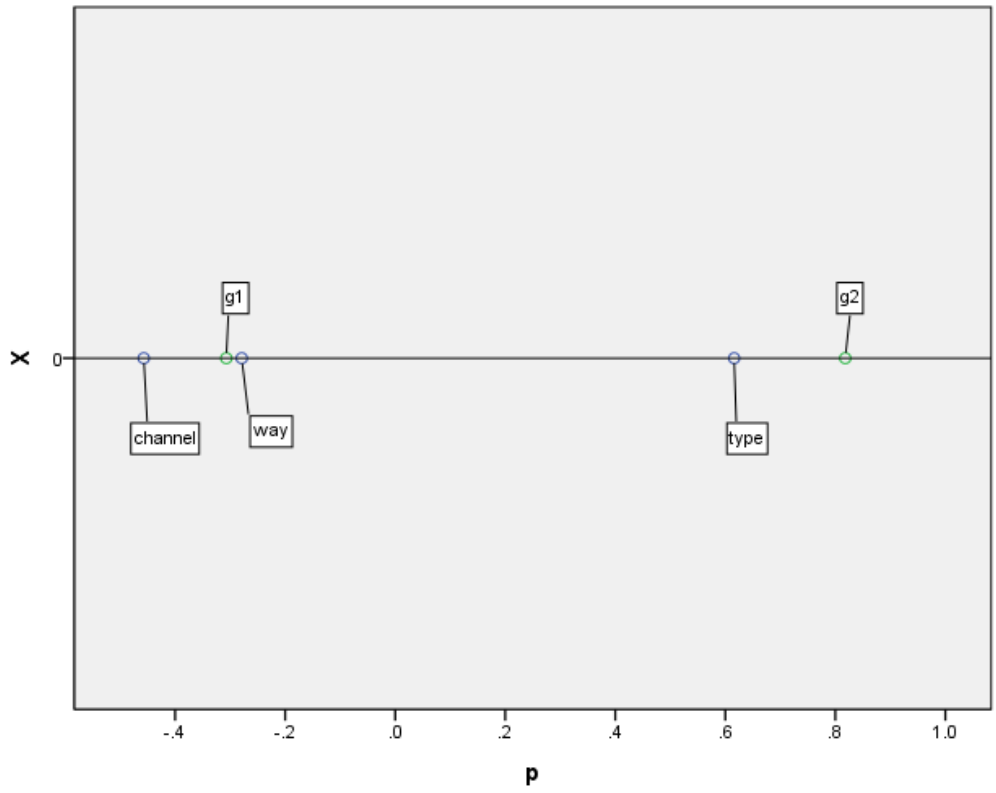

Figure 2: The plot of the background group for the preference characteristics coordinate

From Tables 6, 7, and 9, our empirical data with corresponding analysis confirms the assumption of preference characteristics among people with different backgrounds.

4.4. Managerial Implication

This paper reviews the investment behavior of preference from employees working in those Taiwan's financial institutions. People consider these financial institution employees as informed investors because they have the latest information when the financial markets evolve. However, even that way, we find the behavior biases existing in their investment behavior. The

empirical results show that the investment outcome of employees from Taiwan's financial institutions may be less volatile but have investment preference biases from the analytical ones.

5. Conclusion and Future Directions

Mutual fund investment preference has long been an interesting issue for scholars. The preference bias issue is still in its infancy via a lack of collected data and suitable study methods. We provide a conjoint analysis to investigate the mutual fund investment preference among people with diverse demographics. People consider a worker in Taiwan's financial institutions as experts. Women with longer working years emphasize channel choice because they think trading cost and general information are important factors. They prefer to invest in fixed income mutual funds via bank at a fixed period. Younger men with shorter working years choose banks because of alternative mutual fund selections. They prefer to invest the equity fund via a bank or security firm in a lump sum. Overall, we find out behavioral finance biases in our mutual fund investment preference. Thus, different finance biases exist in different groups.

Mutual fund investment preference bias has been an interesting issue but lacks solid empirical study in Taiwan. Thaler (1985) uses cognitive psychology to indicate the mental coding of gains and losses when people face daily life choices. Investment is an activity with cognitive bias. It makes the investment bias issue more critical. In the future, research should detect the emotional bias and investing trauma with a delicately experimental design on questionnaire survey. Conjoint analysis with correspondence analysis is helpful as cross-validation—the appropriate empirical design insights into Taiwanese financial workers' mutual fund investment preferences with diverse demographic factors.

Besides, this research limitation has several perspectives. The first one is that the data collection process is not easy to repeat when facing a fast-paced workplace in Taiwan's financial institutions. Valuable information from employees with Taiwan's financial institutions is hard to collect by hand. The second research limitation is that conjoint and correspondence analyses are hard to implement when dealing with sophisticated matrix calculation. The calculation is skillful when people consider redoing our research. The last one is the impact of changing environment to the result as the society moves on. People may change their investment perception when having more investment tools on hand. The risk awareness and selection preference may change according to a changing economic environment.

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