An Experimental Research on Decision-making Behavior in Long-term Engineering Project Investment

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Abstract: To investigate the mechanism of decision-making in Long-term engineering project investment, we examined the relationship between investment behavior rigidity and decision makers’ personality. Firstly, we developed an investment decision experiment to measure their behavior rigidity. Secondly, we used the Scale based on the Big Five personality of the International Personality Item Pool to measure their personality. Thirdly, we investigate the relationship between investment behavior rigidity and the Big Five personality. The results are summarized as follow. First, decision makers with higher scores in openness have stronger investment behavior rigidity, and two factors of risk and rationality have a significant impact on investment behavior rigidity. Second, decision makers with higher scores in neuroticism have weaker investment behavior rigidity, and the four factors of anxiety, depression, Immoderation and Vulnerability have a significant impact on investment behavior rigidity. Third, decision makers with higher scores in extraversion have stronger investment behavior rigidity, and the two factors of gregariousness and assertiveness have a significant positive impact on investment behavior rigidity.

1. Introduction
Researchers generally believe that personality traits are importantly related to investment behavior (Evans, 2008; Durand, 2013). In the literature on the study of personality traits, the most dominant model is the Big Five personality (Oehler, 2018). The Big Five personality model divides personality into five overall dimensions, each of which consists of six levels. Investment behavior rigidity is a behavioral indicator that measures to what extent that investors maintain their investment strategies. It refers to the stability and unchangeable characteristics of the investment behavior in the investment process due to factors such as negative information. In an uncertain situation, the market is full of information with unknown authenticity. Investors can’t neither obtain complete information related to decision-making, nor can they accurately judge the authenticity of information and the results of decision-making schemes. They can only rely on limited information, according to the logic of process rationality to make decisions. Investors with stronger investment behavior rigidity will maintain more original investment portfolios in investment decisions, while investors with weaker investment behavior rigidity will change more frequently.

In this paper, we measure the responses of different personality types of investors in the context of continuous investment decision-making through behavioral experiments, and analyze the internal relationship between personality and investment behavior rigidity through sample T test.
2. Literature Review and Hypotheses

2.1. The Big Five Personality
Researchers conducted a lot of studies about the relationship between the Big Five personality and investment behavior. Durand (2013) classified investors into different personality types. They pointed out that the stocks of the investments should be consistent with the personality types in order to generate more returns. Evans (2008) found that individuals with lower applicability, higher intelligence scores, and lower rigor scores accommodate more losses in financial investments. Oehler (2018) used a day's trading data of 80 anonymous traders to find that investors' trading performance was negatively correlated with amenity, neuroticism, responsibility and openness, and positively correlated with extroversion. Mayfield (2008) analyzed the data of the traders and traders of the four investment banks in London and found that the trades performed well and were stable and introverted traders and they were highly openness. Akhtar (2018) found that the exogenous, openness, and conscientiously high scores of investing individuals have higher returns, while those with high neuroticism and amenity scores have lower financial returns. Wang (2014) conducted a questionnaire survey of 1063 investors in seven cities in China, and found that investors have higher knowledge of investment objects, more investment knowledge, and greater possibility of investors' independence and self-efficacy. Equity investors with high extroversion can concentrate their energies and make decisive decisions during investment. They can also eliminate the interference of negative emotions, reasonably analyze and grasp market opportunities and choose rational behaviors. Trading venues are good at getting people to get more information about stock investment decisions. When stocks fall, extroverted individuals may be more rational and decisive, and less affected by sunk cost. Individuals with high appetite are sometimes too skeptical of others' evaluations, and are more susceptible to negative information in the market. It is difficult to adhere to their own ideas in investment decisions. Investors with high agreeableness scores are easy to follow the reaction of most investors in the market. When they see other people buying or selling, they often follow the buying and selling decisions. Individuals with high conscientiousness scores tend to have strong self-discipline, restrain greed when stocks rise, and throw stocks when they fall. Individuals with high neuroticism scores are mainly emotional when operating stocks and are susceptible to incidents. When stock prices change, they often produce extreme emotions and lose their rationality. Investors with high openness are more adventurous, and in the uncertain situation, extroverted investors may have stronger investment behavior rigidity. In addition, the more openness investors are better at getting more information and being able to cope with the complex and volatile stock market.

2.2. Investment behavior rigidity
Investment behavior rigidity refers to the stability and unchangeable characteristics of the investment behavior of the individual in the investment process due to factors such as falling asset prices and negative information. It reflects the persistence behavior of investors in the investment decision in the face of unfavorable information and setbacks. In an uncertain situation, the market is full of information with unknown authenticity. Investors can't neither obtain complete information related to decision-making, nor can they accurately judge the authenticity of information and the results of decision-making. They can only rely on limited information, and make decisions according to the logic of process rationality. Investors with stronger investment behavior rigidity will maintain their original investment portfolio more in their investment decisions, while investors with weaker investment behavior rigidity will change more frequently.

Investment behavior rigidity is a behavioral indicator that measures the extent to which investors maintain their investment objectives and strategies in the investment process. When an investor makes an investment decision, due to changes in the market, the surrounding and other constitutional factors, investors will more or less adjust the investment strategy and even the investment target. For some investors, small changes in decision-making situations will cause them to quickly adjust existing decisions, while for others, they may wait and see, and adjust when the situation changes more. Some
even realize that the situation has changed, but it will not be adjusted until the investment is over. Therefore, the following assumptions are made:

Hypothesis 1: Investors with higher extroversion personality scores have stronger investment behavior rigidity

Hypothesis 2: Investors with higher agreeableness scores have weaker investment behavior rigidity

Hypothesis 3: Investors with higher conscientiousness scores have weaker investment behavior rigidity

Hypothesis 4: Investors with higher openness score have stronger investment behavior rigidity

Hypothesis 5: Investors with higher neuroticism scores have weaker investment behavior rigidity

3. Method

3.1 Subjects
The survey was conducted at Jiangsu Vocational College of Agriculture and Forestry. The subjects are 134 students who had finished two courses of “Secondary Investment Theory and Practice” and “Personal Finance” in the past. They came from 21 different majors and had already learned the basic investment knowledge and can understand the basic operations of the investment.

The study was conducted in a random manner. It was divided into two sessions, each of which was divided into two stages. In the first stage, the participants were asked to fill out the Big Five Personality Questionnaire using a computer. After a rest of ten minutes, they take part in the second stage of the experiment under the guiding of the staff to measure investment behavior rigidity. The two stages required the participants to fill in the basic information. In the later statistics, the two-stage data could be combined and analyzed.

In order to obtain effective data and achieve the purpose of practical and effective research results, the screening criteria are set for the data: (1) The questionnaire with obvious answering rules in the questionnaire answer is deleted. (2) If there is a missing item, delete the questionnaire. (3) In the personality questionnaire, the problem of lie detection was set up. Two questions were asked before and after the question of “Always forget to put things back in the right place” and “Learn time and energy spent learning”, if the questionnaire option If the absolute value of the difference is greater than 2, the questionnaire is excluded. (4) In order to eliminate the influence of psychological valence on the rigidity of investment behavior, the measurement objects are screened, and the age of the subjects to be analyzed is similar to that of ordinary working-class families. The annual household income is about 10-25 thousand yuan. The monthly living expenses are around 800-1800 yuan. A total of 102 data were finally entered into the analysis.

3.2. Measurement
The measurement of this study involves multiple variables, first of all for the measurement of personality. Most of the existing researches on investment decision-making behavior use the small scale personality measurement questionnaire. Some researchers use 50 questions, and some use 20 questions. Although these scales help the questionnaire to be recycled, the quality of the questions is guaranteed, but the measurement of personality is not perfect. This study used the Big Five Personality Scale revised by Yangzhou University in 2016. The scale was based on the Big Five personality of the International Personality Item Pool and was refined. We used AMOS 20.0 verification validity to remove some items that did not meet the criteria (factor load less than 0.45), and finally included 24 items for extroversion; 24 items for amenity; 24 items for conscientiousness; 24 items for neuroticism Openness includes 24 projects, all of which are scored using a 5-level Likert scale.

4. Results

4.1 Extroversion
The statistical results show that there is a significant positive correlation between the ibr score and the
extroversion. The correlation coefficient is 0.209, and the correlation coefficient is significant at the 0.05 level. The correlation coefficient is 0.219, which is significantly correlated with the self-affirmation dimension at the 0.01 level. The correlation coefficient is 0.274. The ibr score is also negatively correlated with whether there is a student loan, the correlation coefficient is -0.229, indicating that the investment behavior of the subjects with relatively poor economic status is more conservative and cautious. In the case of sustained losses, it is possible to stop losses in a timely manner.

Based on the correlation analysis, we performed an independent sample T test on the ibr score. We grouped the samples according to the extrovert personality type index and its six dimensions, the first group being the low level group and the fourth group being the low level group. In the high-level group, compare the mean values between the groups, and the results are shown in Table 1.

The independent sample T test results showed that there were significant differences in ibr scores for different groups of extroversion levels. The mean value of the low-level group of extroversion was 4.84, and the average of the high-level group was 6.77. There were also significant differences in the ibr score between the two groups of extroversion and self-affirmation. The significance levels were 0.05 and 0.01, respectively. This shows that the higher the level of extroversion, the stronger the investment rigid behavior. In terms of personality characteristics, investors with high level of extroversion are more inclined to communicate with the outside world, can obtain information from various aspects to make investment decisions, and investors with higher extroversion have stronger self-affirmation characteristics. Decision-making is made, there is more confidence in the execution of the decision-making, and it is not easy to change your own thinking, hypothesis 1 is verified.

| Table 1. independent sample T-test of Extroversion. |
|-----------------------------------------------|
| Variable          | ibr  | SD   | T     | Sig  |
| Extroversion (low) | 4.84 | 2.794| -2.784**| 0.008 |
| Extroversion (high)| 6.77 | 2.122|       |      |
| Friendliness (low)| 5.08 | 2.857| -1.332| 0.189 |
| Friendliness (high)| 6.00 | 2.020|       |      |
| Gregariousness (low)| 4.96 | 2.879| -2.397*| 0.020 |
| Gregariousness (high)| 6.81 | 2.489|       |      |
| Assertiveness (low)| 5.00 | 2.217| -2.744**| 0.006 |
| Assertiveness (high)| 6.23 | 2.788|       |      |
| Activity (low)    | 5.00 | 2.769| -1.969| 0.055 |
| Activity (high)   | 6.35 | 2.077|       |      |
| Excitement-Seeking (low)| 5.64 | 2.430|     |      |
| Excitement-Seeking (high)| 6.54 | 2.502| -1.300| 0.200 |
| Cheerfulness (low)| 4.84 | 2.749| -1.653| 0.105 |
| Cheerfulness (high)| 6.04 | 2.425|       |      |

4.2 Agreeableness
The statistical results show that the ibr score is only significantly correlated with the modest dimension at the 0.05 level, and the correlation with the pleasantness and other five dimensions is not significant. Based on the correlation analysis, we performed an independent sample T test on the ibr score. We grouped the samples according to the amenity personality type index and its six dimensions, the first group being the low level group and the fourth group being the high level. In the horizontal group, compare the mean values between the groups, and the results are shown in Table 2.

| Table 2. independent sample T-test of Agreeableness. |
|-----------------------------------------------|
| Variable           | ibr  | SD   | T     | Sig  |
| Agreeableness (low)| 4.84 | 2.609| -1.728| 0.090 |
The independent sample T test showed that there was no significant difference in the ibr score between the different groups of the level of pleasantness. For the six dimensions of amenity, the ibr score differs only at the level of the modest dimension, with a significance level of 0.05. From the data results, there is no significant correlation between amenity and investment behavioral rigidity. hypothesis 2 is not verified.

4.3 conscientiousness

The statistical results show that the ibr score has a significant correlation with the due diligence at the 0.05 level, and the correlation between the self-discipline dimension and the prudential dimension at the 0.05 level. Based on the correlation analysis, we performed an independent sample T test on the ibr score. We grouped the samples according to the due diligence personality type index and its six dimensions, the first group being the low level group and the fourth group being the high group. For the horizontal group, compare the mean values between the groups, and the results are shown in Table 3.

The independent sample T test results showed that there were no significant differences in ibr scores for different groups of due diligence levels. For the six dimensions of conscientiousness, the ibr score differs only at the level of the prudential dimension, with a significance level of 0.05. From the data results, the higher the prudence, the higher the ibr score, the stronger the investment behavior rigidity, which indicates that in the investment decision, the more prudent individuals are more cautious and conservative, but often in the development of investment plans. It will take more time and energy, and have more confidence in the choice of investment objectives. Therefore, the original decision will not be easily denied in the later investment. However, the comprehensive correlation analysis and the independent sample T test results, the amenity trait is not significantly related to the investment behavior rigidity. hypothesis 3 is not verified.

| Agreeableness (high) | 6.00 | 2.173 |
|----------------------|------|-------|
| Trust (low)          | 5.52 | 2.888 |
| Trust (high)         | 5.77 | 2.320 |
| Morality (low)       | 5.28 | 2.716 |
| Morality (high)      | 6.12 | 2.321 |
| Altruism (low)       | 5.16 | 2.794 |
| Altruism (high)      | 6.15 | 2.310 |
| Cooperation (low)    | 5.20 | 2.466 |
| Cooperation (high)   | 6.04 | 2.863 |
| Modesty (low)        | 4.76 | 2.803 |
| Modesty (high)       | 6.46 | 1.944 |
| Sympathy (low)       | 5.72 | 2.937 |
| Sympathy (high)      | 6.46 | 1.606 |

The independent sample T-test of conscientiousness.

|                | ibr  | SD   | T    | Sig  |
|----------------|------|------|------|------|
| conscientiousness (low) | 5.20 | 2.291 | -1.845 | 0.071 |
| conscientiousness (high)  | 6.42 | 2.436 | -1.120 | 0.268 |
| Self-Efficacy (low)       | 5.40 | 2.566 | -1.120 | 0.268 |
| Self-Efficacy (high)      | 6.12 | 1.966 | -1.120 | 0.268 |
| Orderliness (low)         | 5.44 | 2.181 | -1.287 | 0.204 |
| Orderliness (high)        | 6.31 | 2.604 | -1.257 | 0.215 |
| Dutifulness (low)         | 5.52 | 2.551 | -1.257 | 0.215 |
| Dutifulness (high)        | 6.42 | 2.580 | -1.257 | 0.215 |
| Achievement-Striving (low)| 5.36 | 2.548 | -1.738 | 0.089 |
| Achievement-Striving      | 6.62 | 2.609 | -1.738 | 0.089 |
4.4 Openness

The statistical results show that the correlation between ibr score and openness is significant at the 0.01 level, and the risky and rational dimensions are significantly correlated at the 0.01 level, and the aesthetic dimension is significant at the 0.05 level.

Based on the correlation analysis, we performed an independent sample T test on the ibr score. We grouped the samples according to the open personality type index and its six dimensions, the first group being the low level group and the fourth group being the high level. For the horizontal group, compare the mean values between the groups, and the results are shown in Table 4.

The independent sample T test results showed that there were significant differences in the ibr score at the 0.01 level for the different groups of openness levels. The mean for the low level group was 4.04 and the mean for the high level group was 6.77. Among the six dimensions of openness traits, there are significant differences in ibr scores between different groups of risky levels and different levels of rationality. Groups with low risk of low-level, ibr mean value of 4.92, high risk group, ibr mean value of 5.81, which indicates that individuals with higher risk are more risk-seeking tendencies in continuous investment decisions. In the investment setbacks, more opportunities are often seen, so it is more willing to risk the original investment and the more rigid the investment behavior. For groups with low rationality, the average ibr value is 5.12, and the average level of ibr, the average ibr value is 6.96. This shows that investors with higher rationality have stronger independent thinking ability and are more cautious about the trend and prospects. More confidence in previous investment decisions, not easily affected by external factors, and investment behavior is more rigid. Investors with lower sane are often more susceptible to external information, such as the judgment of others, the lowering of prices, etc., which makes them more prone to chasing up and down, and the weaker the investment behavior. Based on the comprehensive correlation analysis and the independent sample T test results, the openness trait is significantly correlated with the investment behavioral rigidity, and hypothesis 4 is verified.

Table 4. independent sample T-test of Openness.

|                          | ibr   | SD   | T     | Sig |
|--------------------------|-------|------|-------|-----|
| Openness (low)           | 4.04  | 2.55 | -4.079** | 0.000 |
| Openness (high)          | 6.77  | 2.21 |       |     |
| Imagination (low)        | 5.84  | 1.88 | -0.684 | 0.497 |
| Imagination (high)       | 6.28  | 2.60 |       |     |
| artistic Interests (low) | 5.48  | 2.43 | -1.865 | 0.068 |
| artistic Interests (high)| 6.69  | 2.20 |       |     |
| Emotionality (low)       | 4.92  | 2.66 | -1.200 | 0.236 |
| Emotionality (high)      | 5.81  | 2.62 |       |     |
| Adventurousness (low)    | 4.92  | 2.66 | -2.764** | 0.008 |
| Adventurousness (high)   | 5.81  | 2.62 |       |     |
| Intellect (low)          | 5.12  | 2.50 | -2.667** | 0.010 |
| Intellect (high)         | 6.96  | 2.37 |       |     |
| Liberalism (low)         | 6.16  | 2.64 | -0.110 | 0.913 |
| Liberalism (high)        | 6.24  | 2.52 |       |     |
4.5 Neuroticism

The statistical results show that the correlation between ibr score and neuroticism is significant at the 0.01 level, and the correlation between the depression dimension and the vulnerability dimension is significant at the 0.01 level, and the anxiety and impulsive dimensions are significant at the 0.05 level.

| Table 5. independent sample T-test of Neuroticism. |
|-----------------------------------------------|
|                | ibr | SD  | T      | Sig   |
|----------------|-----|-----|--------|-------|
| Neuroticism (low) | 7.44| 2.123| 4.594**| 0.000 |
| Neuroticism (high) | 4.52| 2.365|        |       |
| Anxiety (low)    | 6.88| 2.555| 2.397* | 0.020 |
| Anxiety (high)   | 5.20| 2.398|        |       |
| Anger (low)      | 6.72| 2.407| 1.588  | 0.119 |
| Anger (high)     | 5.72| 2.031|        |       |
| Depression (low) | 6.72| 2.283| 3.427**| 0.001 |
| Depression (high)| 4.52| 2.257|        |       |
| Self-Consciousness (low) | 6.32| 2.268| 1.744  | 0.088 |
| Self-Consciousness (high)| 5.08| 2.737|        |       |
| Immoderation (low) | 7.00| 2.062| 2.713**| 0.009 |
| Immoderation (high)| 5.24| 2.505|        |       |
| Vulnerability (low) | 7.36| 1.890| 3.315**| 0.002 |
| Vulnerability (high)| 5.32| 2.428|        |       |

Based on the correlation analysis, we performed an independent sample T test on the ibr score. We grouped the samples according to the neurotic personality type index and its six dimensions, the first group being the low level group and the fourth group being the high level. The results are shown in the table 5.

The independent sample T test results showed that the ibr scores were significantly different at different levels of 0.01 in the different groups of neuroticism. The mean of the low-level group was 7.44, and the mean of the high-level group was 4.52. Among the six dimensions of neurotic traits, the ibr scores were significantly different between different groups of anxiety levels, different groups of depression levels, different groups of impulsive levels, and different levels of vulnerability levels. In the group with low anxiety level, the average ibr value is 6.88, and the group with high anxiety level has an average ibr value of 5.20. The higher the anxiety level, the more often the investor suffers from the loss, the lack of confidence in the established investment decision, and the difficulty in resisting the setback. The investment target is frequently changed, and the investment behavior is less rigid. In the group with low depression level, the average ibr value was 6.72, and the average level of ibr was 4.52. There was a strong correlation between the depression dimension and the anxiety dimension. The two had the same effect on the investment behavior rigidity. Investors with higher levels of depression are more susceptible to external influences and persistent anxiety, which in turn frequently changes investment targets and may even lead to over-trading. For the group with low impulsiveness, the average ibr value is 7.00, the group with high impulsive level, the average ibr value is 5.24, the group with low vulnerability level, the average ibr value is 7.36, and the group with high vulnerability level, ibr mean 5.32. Based on the comprehensive correlation analysis and the independent sample T test results, the neurotic traits were significantly correlated with the investment behavioral rigidity, hypothesis 5 was verified.

5. Conclusions

In this paper, the personality traits and investment behavior rigidity of investors are measured by experiments, and the independent sample T test is carried out to obtain the relationship between personality traits and investment behavior rigidity. The more open-minded individuals in the Big Five personality, the stronger the investment behavior is rigid. Among them, the two dimensions of risk and
rationality have a significant impact on the rigidity of investment behavior. The stronger the neurotic, the weaker the investment behavior, and the four dimensions of anxiety, depression, impulsivity and vulnerability have a significant impact on the rigidity of investment behavior. In the independent sample T test, the stronger the extroversion, the stronger the investment behavior rigidity, and the two dimensions of merging and self-affirmation have a significant positive impact on the rigidity of investment behavior.

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