The Construction of Investment Rationality Index

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Abstract

The paper mainly discusses the operational definition of investment rationality and proposes the measuring criterion through the analysis of individual's sensitivity to noise information and material information from the view of signal detection theory. According to the measuring criterion, the authors design an experiment, which contains risk level and risk presentation, standing for material information and noise information respectively, as independent variable and financial product acceptance as dependent variable. Through variance decomposition, the effects of material information and noise information on financial product acceptance can be calculated, on the basis of which investment rationality can be measured. The investment rationality index will be helpful for the further study of investment rationality.

Keywords: investment rationality, material information, noise information

1. Introduction

With the deepening of the Chinese economic reform and opening-up policy as well as the acceleration of marketization process, in this modern society, people have greater freedom and wider range of choices. 25 years ago under the framework of planned economy, financial products or financial market are totally uncharted waters for Chinese people, who needn't and couldn't think about a better way to keep their idle money to maintain it or make it grow in line with their anticipation. After Chinese economic reform and opining-up policy, the first share was issued in 1984, the first stock exchange was established in 1990 and the first futures exchange was set up in 1999 in China. Since then, Chinese people began to know about such financial concepts as share, bond and futures. In addition, over years after China's accession to the WTO, the financial industry grew rapidly, and the endless emergence of financial products provided people with more investment channels and bigger investment scope. In response to the rapid growth of the financial market, Chinese government has established a financial regulatory system, in which People's Bank of China is mainly responsible for macro-control and China Banking Regulatory Commission, China Insurance Regulatory Commission, China Securities Regulatory Commission exercise separate supervision. Meanwhile, financial legislation has also been gradually improved: Insurance Law of the People's Republic of China was enacted in 1995 and revised in 2002, 2009 and 2014; Commercial bank law of the People's Republic of China was introduced in 1995 and revised in 2003; The securities law of the People's Republic of China was issued in 1998 and revised in 2005 and 2013. The three financial laws all made some regulations about the information disclosure of financial products, but is it enough for people to make correct judgment only according to the content stipulated by information disclosure? The key information and right choices can influence people's future return, so can they filter the information from the mass information disclosed and make the right choices? This is very important for common people's well-being and the social stability.

As mentioned above, people nowadays enjoy the freedom brought from market economy; meanwhile they also face unprecedented risks. During the period of planned economy, people need not worry about the possible loss due to poor assets disposal. In early stage of marketization, unskillful investment wouldn't bring too much bad influence, because financial products accounted for a comparatively lower proportion in people's asset portfolio. But, nowadays along with the development of Chinese capital market, and as China's opening degree increases and the pension reform is pushed forward gradually, gone are those days when people could live a steady life only by depositing all their idle money in the bank. People are somewhat linked to the financial market actively or passively. Likewise, with the enhancement of this connection, mistake in investment will greatly influence their life in the future. So it is very important for common people to know how to invest rationally in 21st century. What is rational investment?

How to measure investment rationality? As the financial industry develops rapidly, these questions are becoming increasingly important. Therefore, this research constructs the operational definition of investment rationality.

2. Literature Review

Many financial scholars are interested in the field of rational investment. They have done researches in investment rationality of enterprise administrators at the corporate level and found that administrators have cognitive bias, which led to irrational investment decisions (Jensen & Meckling, 1976; Jensen, 1986; Richardson, 2006). Compared with enterprises' investment, investment rationality in financial market has deep influence on more people. There is some noise in the financial market that influences investors' rational judgments. Some scholars hold that noise hinders prospective earnings of the stock and investment portfolio, and that noise trade results in to a big extent the risk of the financial market (Black, 1986). Likewise, factors of investor may lead to irrational investments. For example, some scholars hold that the market is composed of two kinds of investors: the arbitrager and the noise trader. Arbitrager was defined as investors who have rational expectations on security benefits, while noise traders' option as well as trading style exhibited systematic deviation. Noise trade was believed to have negative influence on other market participants and society (Shleifer & Summers, 1990). And some research hold that people tend to overestimate the precision of their knowledge and information, for example, men are more overconfident in making investment decisions and have more trading impulses than women (Barbe & Odean, 2000). And this impulsive trade mostly led to loss; however, these investors overestimate prospective earnings of trading and frequently buy and sell, which results in high volume (Odean, 1998). Besides, the factor of investors and market noise sometimes interact, for example, experienced decision makers took more information sources into their consideration and were more sensitive to changes of information (Browne, 2007).

Investment rationality is of great interest for many scholars, but from literature review it can be found that the quantitive studies of investment rationality focused on only the enterprise level, taking irrationality as measuring object, and mainly adopting the deviation of the actual investment level of the enterprise from the anticipated investment level, which is estimated with anticipated investment model (Richardson, 2006; Li Bin & Zhang Ruijun, 2013). There are comparatively fewer researches in investment rationality on individual level, most of which only focused on phenomenal descriptions. Therefore, it would be of great significance to construct the operational definition of invest irrationality on individual level.

3. Objectives of Research

This research explores the influence of noise information (risk presentation) and material information (risk level) on the financial product acceptance. Then, with basic ideas of the signal detection theory, operational definition of investment rationality for individual would be constructed basing on sensitivity to material information and noise information, with the method of experiment.

4. Operational Definition of Investment Rationality

With redundant information, rational investors should strip away invalid information and make judgments according to information that has real effects on the return and risk of investment. While for irrational investors there are often two situations: first, insensitive to material information, that is, they don't respond to information that has real effects on the return and risk of investment. Second, sensitive to noise information, in other words, their investment decisions would be affected by the information having no real effects on the return and risk of investment. This research would take risk level as material information and risk presentation as noise information.

Hence, for the rational investor, the investment plan should be adjusted in accordance to the variation of risk level while maintain constant when the description of same risk changes. So, the more rational investor is, the greater the divergence in preferences for different risk levels of financial products is, meanwhile the less the divergence in preferences for the same risk level with different description is. And in this study, the discrepancy in choices given the same risk level with different risk presentations represent sensitivity to noise information (the lower the value is, the more rational the investor is), and the discrepancy in choices with different risk levels and constant risk presentation represents sensitivity to material information (the higher the value is, the more rational the investor is). But there are some occasions to overestimate or underestimate investment rationality if sensitivity to noise information and sensitivity to material information are taken as investment rationality separately. For example, the answer tendency (the subject gives the same answers to all the questions) can lead to underestimation of sensitivity to noise information, while randomized answer will lead to the overestimation of sensitivity to material information. In both cases, investment rationality will be overestimated. Fortunately, the deviation direction is the same for sensitivity to noise information and sensitivity to material information, that is, when the answer tendency

underestimates sensitivity to noise information (overestimate the investment rationality), it will also underestimate sensitivity to material information (underestimate investment rationality). While the randomized answer overestimates sensitivity to noise information (overestimate the investment rationality), it will also underestimate sensitivity to material information (underestimate the investment rationality). As mentioned above, the lower sensitivity to noise information is, the more rational the investor is; the higher sensitivity to material information is, the more rational the investor is. So, with the ratio between sensitivity to material information and sensitivity to noise information standing for the investment rationality, it can perfectly avoid the overestimation and underestimation caused by answer tendency and randomized answer.

5. Research Method

The core content of this research is to construct an operational definition of the investment rationality. To better explore the influence of risk presentation and risk levels on the financial product acceptance of different kinds of investors, and to measure the degree of investment rationality, the following experiment is designed:

There are two independent variables in this study, namely risk presentation which stands for noise information and risk level which stands for material information. And the dependent variable is financial product acceptance which can be measure on what percentage of the money the subject would be used to buy finance product. For the detailed information, please refer to the following instruction as below:

A. Independent variable 1: Noise information – risk presentation:

P1: There is a 9 in 10 chance of a return between x % and y %.

P2: There is a 1 in 10 chance of a return outside x % and y %.

P3: There is a 1 in 20 chance of a return above y %.

P4: There is a 1 in 20 chance of a return below x %.

P5: 2 options are shown in the chart 1 below.

Choice A: 100% bank account, the rate of return is always exactly x % (purple dot)

Choice B: There is a 9 in 10 chance of a rate of a return in the green box.

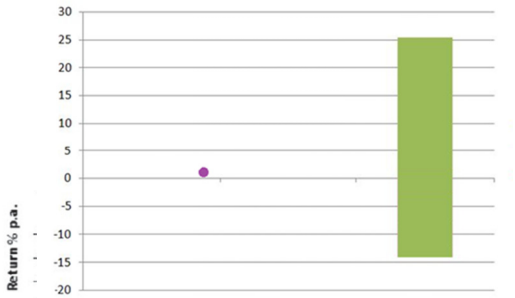

Chart 1. The return of bank deposit and financial product

B. Independent variable 2 material information – risk levels

R1 low risk: x=-14 y=25.5

R2 high risk: x=-34.5 y=55.5

C. Dependent variable – financial product acceptance

It is measured by proportion of the idle money used purchasing financial product, and the specific measurement mode as follow:

Suppose you only have 200 thousand RMB idle money and you need to deposit it in two ways (bank deposit and financial product) as below, what percentage are you willing to invest in financial product?

Table 1. Experiment design

Option type	Average annual rate of return	Risk level
Deposit in bank	2%	Risk-free
Financial product	4.50%	IV1(P)*IV2(R)

6. Construction of Investment Rationality Index

In the experiment, given a certain risk level with different risk presentations, individual's discrepancy in investment proportion of financial product stands for sensitivity to noise information. In other words, given a certain risk level with different risk presentations, the standard deviation of investment proportion of financial product represents the sensitivity to noise information. Because there are two risk levels in the experiment, two above-mentioned standard deviations can be obtained. The average of the two standard deviations is more stable, which can be better representing individual's sensitivity to noise information. Likewise, with the same risk presentation, individual's change in investment proportion of financial product for the alteration of risk level stands for the sensitivity to material information, that is, given certain risk presentation and different risk levels, individual' s standard deviation of investment proportion of financial product represents sensitivity to material information. Since there are five different risk presentations, five such standard deviations for each individual could be obtained. And the average of the five standard deviations is more stable than each of the five, which better represents sensitivity to material information.

Because different individuals have diverse investment proportions of financial product (average value), the standard deviation alone is not the proper index to compare sensitivity to information for different individuals. In order to make it comparable for different individuals, we calculate variable coefficient (the ratio between standard derivation mentioned above and the average value for investment proportion of financial product). Meanwhile, another problem to be concerned is the possible ceiling effect and floor effect. Because we only choose two risk levels and five risk presentations in this study, which is far from covering the information provided of financial product in real life. The test result may exaggerate or underestimate investment rationality for some individuals. For example, some individuals are quite rational, which means in this experiment they are only sensitive to material information but not to noise information. Hence their sensitivity to noise information calculated as mentioned above is zero. Of course he ranks first among all the individuals of this experiment. But in real life, it is impossible for this individual to actively ignore all the noise information, which means the ceiling effect occurs in this circumstance. In order to decrease the derivation between the measure of this experiment and reality caused by the ceiling and floor effect, the average value of all individuals' investment proportions of financial product under every treatment would be added to the numerator and denominator of variable coefficient. The ratio calculated in this way better represents sensitivity to material and noise information. And the ratio between the sensitivity to material information and noise information can comprehensively stand for investment rationality. (Formulation is as below).

Table 2. Individual i' financial product acceptance under the ten treatments

		Noise information					
		P_1	P_2	P_3	P_4	P_5	
Material Information	R_1	$X_{iP_1R_1}$	$X_{iP_2R_1}$	$X_{iP_3R_1}$	$X_{iP_4R_1}$	$X_{iP_5R_1}$	σ_{iR_1}
	R_2	$X_{iP_1R_2}$	$X_{iP_2R_2}$	$X_{iP_3R_2}$	$X_{iP_4R_2}$	$X_{iP_5R_2}$	σ_{iR_2}
		σ_{iP_1}	σ_{iP_2}	σ_{iP_3}	σ_{iP_4}	σ_{iP_5}	

$$\sigma_{iR} = \frac{1}{2}\sum_{k=1}^{2} \sigma_{iR_k}$$

$$\sigma_{iP} = \frac{1}{5}\sum_{j=1}^{5}\sigma_{iP_j}$$

$$\bar{X} = \frac{1}{10n}\sum_{i=1}^{n}\sum_{k=1}^{2}\sum_{j=1}^{5}X_{iP_jR_k}$$

$$\bar{X}_i = \frac{1}{10}\sum_{k=1}^{2}\sum_{j=1}^{5}X_{iP_jR_k}$$

Subject i's sensitivity to material information = $\frac{\sigma_{iP}+\bar{X}}{\bar{X}_i+\bar{X}}$

Subject i's sensitivity to noise information = $\frac{\sigma_{iR}+\bar{X}}{\bar{X}_i+\bar{X}}$

Subject i's investment rationality = $\frac{\sigma_{iP}+\bar{X}}{\sigma_{iR}+\bar{X}}$

Where X_{iPaRb} is percentage of the money individual I would like to invest in financial product with the a presentation for the b risk level, σ_{iR} is standard deviation in percentage of the money individual I would like to invest in financial product given the same risk level with different risk presentations, σ_{iP} is standard deviation in percentage of the money individual I would like to invest in financial product for different risk levels with the same risk presentation.

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