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Rank Correlation Analysis of Investment Decisionfor Small Investors in the Hong Kong Derivatives Markets

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Abstract. The primary objective is to investigate the factors, investing characteristics and decision making processes that affect Hong Kong's small investors who participate in derivatives markets. The data were collected from 1,130 respondents via a questionnaire survey. Based on the results, we can derive the ascending order of importance of reference group, return performance and personal background (reference group is the least important and personal background is the most important). We used an indicator (Kendall rank correlation coefficients) to measure the different ranking of factors and are therefore attempting to give advice for financial advisers approaching target customers (small investors) in the Hong Kong derivatives markets.

Keywords. Rank correlation**, I**nvestment decision, Small investors, Derivatives markets, Hong Kong.

JEL. G02, G10 G11.

1. Introduction

In Hong Kong, small investors have actively participated in the derivatives markets. Derivative products including warrants, Callable Bull/Bear Contracts (CBBC), options and futures are the popular choices of the small investors.It is therefore interesting to understand how the small investors make the decisions in the derivatives markets.The primary objective is to investigate the factors, investing characteristics and decision making processes that affect Hong Kong's small investors who participate in derivatives markets. Some small investors make investment decision easily, but for other small investors, they do not make investment decision. Also, the dilemma of investment decision is popular for small investors. This is a problem offering two possibilities neither easy make investment decision nor they do not make investment decision. It means that a problem offers two possibilities neither of which is practically acceptable. Small investors have great difficulty making investment decision. In the present study, we employ exploratory factor analysis and the Kendall rank correlation coefficient as our empirical framework. Exploratory factor analysis can help to extract latent factors that can summarize the correlation of the investment decisions and characteristics of the investors' behaviours. Also, we used an indicator (Kendall rank correlation coefficients) to measure the different ranking of factors and are therefore attempting to give advice for financial advisers approaching target customers (small investors) in the Hong Kong derivatives markets.After a careful review of literature on investment decision, we found that a number of journal articles were

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written examining investment decision, but unfortunately, there is dearth of scholarly studies on dilemma of investment decision in regard to the Hong Kong derivatives markets. This study aims to fill the literature gap. We undertook a questionnaire survey to conduct our study with 1,130 respondents. The sample size is large enough for factor analysis and rank correlation analysis.

The rest of the paper is organized as follows. Section 2 reviews the related literature, followed by Section 3 that explains the methodology of the present study and the data. Section 4 reports the results, and the last section contains the conclusion.

2. Literature Review

Although many personal and situational factors may influence the behaviour of small investors in the Hong Kong derivatives markets, research on this topic is sparse. According to the Prospect Theory of Tversky & Kahneman (1974) the decisions made by decision-makers differ from the presumptions of economists, which they proved with the help of various experiments. Kahneman & Tversky (1979) illustrated that the investors usually try to avoid taking risk when they are gaining, however they might choose to take risk when they are with losing stocks. Based on Enoma & Isedu (2010) respond and analysis, it was asserted that investment decision making and risk assessment are multi criteria processes that cannot be defined or captured only by rigid mathematical quantitative factors. Qualitative decision making such as political, social religious and government intervention are among those factors that influence manager investment decision making in insurance company in Nigeria. Sparaggis' (1995) paper presents a top-down modeling framework that can be used to estimate excess valuations and yield spreads and to assist portfolio managers in adjusting their investment strategies according to prevailing markets conditions. This framework combined with the classical bottom-up approach of market valuation can increase a portfolio manager's confidence in determining market entry and exit points. Moreover, Korniotis & Kumar (2011) suggested that older people make better investment choices as they gain more investment knowledge and experience, and questioned whether deterioration of their investment skills with age was largely due to the adverse effects of cognitive ageing. Williams (2007) found little evidence that demographic factors affect socially responsible investment decision.

3. Methods and Data

Before we begin using the survey dataset for analysis, we need to ensure the survey results are reliable enough. According to Carmines & Zeller (1979), reliability focuses on the extent to which the empirical indicator provides consistent results across repeated measurements. It should be noted that the measure used to assess the statistical significance of the item was coefficient of variation (CV), which expresses the ratio of the standard error to the arithmetic mean $CV = \frac{S_{\bar{x}}}{|\bar{X}|}$. Accordingly, it was considered the consensus had been achieved when the level of item was on the statistically significant (that is $CV \leq 20\%$). The CVs for each of questionnaire items have been inserted to the Results on investment behaviour ofsmall investors in derivatives markets in Hong Kong survey in the Appendix. Taking a look at these CVs, we can find the maximum and minimum value is 13.5% and 0.9% respectively with mean 3.96%.

The purpose of factor analysis is to summarize pattern of interrelationship among variables (items) and establish levels of variance in decision variable as they influence a given phenomenon. To examine possible differences in the perceived importance of the key factors, our analyses indicate that out of four criteria (i.e., rotated principal component loadings, scree test, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity, reliability test) examined. Bartlett's test of sphericity and Kaiser-Meyer-Olkinis to test the appropriateness of the sample from the population and the suitability of factor analysis.If Bartlett's test of sphericity is large and significant and the Kaiser-Meyer-Olkin measure is greater than 0.6, then factorability is assumed. If the sums of squares of the loadings on the extracted factors are no longer dropping but are remaining at a low and rather uniform level, factor extraction may be reasonably terminated. Cattell's (1966) Scree test is based on this principle. SPSS use a default option of extracting all principal factors with eigenvalues of 1.0 or more (i.e., the Kaiser-Guttman rule). The main thing to consider in deciding when to stop factoring is that it is better to err on the side of extracting too many factors rather than too few. One of the most commonly used is Cronbach's coefficient α, which is based on the average correlation of items within a reliability test if the items are standardised. Cronbach's coefficient α can be interpreted as a correlation coefficient; it ranges in value from 0 to 1. We agree that some small investors make investment decision easily and some other small investors do not make investment decision. Thereare absolutely opposite to each other in terms of key factors. We create ranking order of determinants that are common for all investment decisions: reference group, return performance andpersonal background. But why they are so different? Rotated principal component loadings, scree test, Kaiser-Meyer-Olkinand Bartlett's test, reliability test are used to examine possible differences in the perceived importance of the key factors. This ranking is different for every small investor. As a result, each small investor has used some key factors from the literature as potential determinants of the investment decision. We can say even more; in the case of somesmall investor make investment decision easily and other small investor do not make investment decision. These rankings are exactly opposite as we will show here. Can these differences be measured? We try to do that using the idea of ranking correlation developed by the British mathematician Kendall (1955) to measure these differences as differences between determinants ranking orders. In order to compare two ordered sets (on the same set of objects); the approach of Kendall is to count the number of different pairs between the two ordered sets. The number that gives a distance between these sets is called the "symmetric difference distance" (the symmetric difference is a set operation which associates with two sets of elements that belong to only one set).

$$\tau = 1 - \frac{2 \text{ x } [d_{\Delta}(P_{1}, P_{2})]}{N\,(N-1)}$$

The symmetric difference distance between two sets of ordered pairs P_1 and P_2 is denoted $d_{\Delta}(P_{1}, P_{2})$. N is number of ranked elements (i.e. determinants), in our case N = 3. With N = 3 elements we assume arbitrarily that first order is equal to 123. Therefore, with two rank orders provided on N determinants, there are N! (i.e. N! = 3! = 3 x 2 x 1 = 6) different possible outcomes (each corresponding to a given possible order) to consider for computing the sampling distribution of τ .Kendall coefficient can have values between -1 and +1: $-1 \leq \tau \leq +1$ where -1 is the largest possible distance (equal to -1, obtained when one order is the exact reverse of the other order), it means that small investor do not make investment decision; +1 is the smallest one (equal to +1, obtained when both orders are identical), it means that small investors makes investment decision easily; and 0 is in the middle one, it means that small investor has great difficulty making investment decision. Kendall coefficient is equal to zero that means the dilemma of investment decisionfor the different ranking of factors. The Kendall coefficient τ can be interpreted as the difference between the probability to have determinants in the same order and the probability that they are in the different order:

τ = P (same) – P (different).

We use the Kendal coefficient between two ordered sets for selected three small investors: Q, T and U.

The data for the present study were collected from small investors in Hong Kong via questionnaire survey. Its main purpose is to collect the opinions, investment behaviour, and financial decision making of the respondents in the Hong derivatives market. The survey was conducted during 21 January 2014 – 21 March 2014. Since the majority of Hong Kong's population is Chinese, the questionnaire was written in Chinese. After a pilot test on nineteen respondents, some amendments (such as rewording of some questions to eliminate ambiguities) were made before we finalized the questionnaire. This questionnaire consists of 9 questions (items): 3 questions for personal background, 4 questions for return performance, 2 questions for reference group.Since some respondents did not reply to all the questions in the questionnaire, we only used the number of replies (i.e., the questions that respondents did not answer were excluded) to calculate the total number of and the percentage of the total for the individual entries.

We selected the respondents using non-probability sampling (snowball method). A group of undergraduate students helped to distribute the questionnaires to the respondents. The target population is the small investors on derivatives markets in Hong Kong. Finally, we distributed 1,200 questionnaires to our students. There were 1,130 selected respondents who completed and returned the questionnaires and this represents a response rate of 94%.

4. Results

The basic information about the respondents is depicted in Appendix. 41.7% of the respondents have less than 3 years of experience of investing in financial market. 40% of them have 3 years and under 10 years of experience of investing in financial market. The majority of the respondents (94%) are in the age group of 18-54. The median income was $18,320. 40.1% of respondents invested 10% to under 30% of the total amount in their investment in derivatives products. About one-third of them have an average return of less than 10% and another one-third of them have an average return of 10-30%. Most of these respondents reported that they have a medium (45.4%) or high (25.9%) level of tolerance for investment risk. 18.5% of the respondents expected that if the Hang Seng Index has increased consecutively over past three days, 20% to under 30% probability that it will increase in value during tomorrow. The respondents also reported that they obtained the information and opinion that affected their investment decision from various sources such as overall past performance of the market seen from a historical perspective (22.7%). Recommendations, advice and forecasts from professional investors (21.3%). Warrants were the most favourite products; the results from item 9 indicate that 24.0% traded it most frequently. The second frequently traded derivatives product was stock options, with 23.0% of the respondents; the third frequently traded was Hang Seng Index futures, with 19.3% of the respondents; the fourth frequently traded was Callable Bull/Bear Contracts (CBBC), with 17.6%; the fifth frequently traded was Hang Seng Index options, with 12.3% of the respondents; the least frequently traded was Renminbi Nondeliverable forwards contract, only with 3.7% of the respondents.In view of the above survey results, we believe that respondents are representative of small investors in Hong Kong derivatives markets.

The goal of factor analysis is to reproduce observed correlations among variables by identifying a smaller number of shared factors that account for the observed correlation. The correlations between the variables arise from the sharing of common factors. The common factors in turn are estimated as linear combinations of the original variables. To identify the underlying dimensions of the items, which are perceived to be important by the respondents, the 9 items were then factor analysed. Initial visual assessment of the correlation matrix indicated considerable degree of inter-factor correlation (see Table 1). In addition, from the correlation matrix, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy gives a value of 0.688. The KMO is close to 1 which represent a perfectly adequate sample and the Barlett's test of Sphericity show a chi-square of 1,419.8 and a significance level of 1% (i.e. $\rho < 0.000$).

Table 1.*Correlation matrix*

Item	1	2	3	4	5	6	7	8
2	0.614**							
3	0.465**	0.418**						
4	0.052	0.061*	0.168**					
5	0.193**	0.146**	0.258**	0.468**				
6	0.162**	0.090**	0.260**	0.365**	0.293**			
7	0.110**	0.097**	0.115**	0.238**	0.229**	0.220**		
8	0.045	0.068*	-0.022	-0.031	-0.085**	0.002	0.050	
9	-0.087**	-0.007	-0.079*	-0.022	-0.025	-0.106**	-0.090**	0.062*

Notes: *Correlation is significant at the 0.05 level (one-tailed) and **Correlation is significant at the 0.01 level (one-tailed).Extraction method: principal component analysis, Rotation method: Varimax with Kariser Normalization, Kaiser-Meyer-Olkin (KMO) index: 0.688, Bartlett's test of Sphericity: approx. Chi-Square= 1,419.8; $\rho<0.000$.Item name (see also Table2) 1.Experience, 2.Age, 3.Income, 4.Portfolio, 5.Average Return,6. Tolerance, 7.Expectation, 8.Information, 9.Types.

Table 2 shows that the proportion of thevariance of a variable is explained by common factor. Given that our aim was to identify the minimum number of factors that would account for the maximum portion of variance of original items, the principal component analysis was selected (Nunnally, 1978) to reduce the number of factors with an eigenvalue greater than 1. The social science rule stipulates that only factor with eigenvalue is greater or equal to 1 and above are considered meaningful for interpretation. Acumulative percentage of variance explained being greater than 50% is the criteria used in determining the number of factors. On the basis of the criteria, three factors were extracted.

Table 2.*Principal component analysis*

Item	Item name	Communality	Factor (Component)	Eigenvalue	Per cent of variance	Cumulative per cent
1	Experience	0.758	1	2.432	27.020	27.020
2	Age	0.714	2	1.548	17.200	44.220
3	Income	0.545	3	1.055	11.722	55.942
4	Portfolio	0.630				
5	Average Return	0.554				
6	Tolerance	0.461				
7	Expectation	0.321				
8	Information	0.597				
9	Types	0.453				

The three factors, collectively, accounted for a satisfactory 55.942% of the variance. Communality values in between 1.0 and 0 indicate partial overlapping between the items and the factors in what they measure. Furthermore, the communality column, provides further evidence of the overall significance, albeit, moderate, of the solution.

The underlying rationale for the Scree test is based on the fact that within a set of items, a limited number of factors are measured more precisely than the others. In reference to the eigenvalues, we would expect three factors to be extracted because they have eigenvalues greater than 1. The Cattell scree test plots the components as the X axis and the corresponding eigenvalues as the Y-axis. As one moves to the right, toward later components, the eigenvalues drop. When the drop ceases and the curve makes an elbow toward less steep decline, Cattell's scree test says to drop all further components after the one starting the elbow. This rule is sometimes criticized for being amenable to researcher-controlled "fudging". That is, as picking the "elbow" can be subjective because the curve has multiple elbows or is a smooth curve, we may be tempted to set the cut-off at the number of factors desired by our research agenda. By graphing the eigenvalues, we found that the smaller factors form a straight line sloping downward. The dominant factors will fall above the line. Figure 1 demonstrates a three-factor solution is obtained.

Figure 1.*Scree plot*

In order to achieve a meaning factor loading, the principal component matrix rotated by orthogonal transformation by varimax with Kaiser normalization. After the rotation, there are no negative loadings on any consequence on eitherfactor A, factor B, or factor C. We found three factors affecting the behavior of small investors on derivatives markets in Hong Kong as follows: factor A might be interpreted as personal background which includeinvestment experience in financial markets (experience), age group (age) and average monthly income (income); factor B as return performance which includethe percentage of derivatives products to the total amount in small investors' investment portfolio (portfolio), average return on investment in derivative products (average return), personal level of tolerance for investment risk(tolerance)andprobability that Hang Seng Index willincrease in value during tomorrow (expectation); factor C as reference groupwhich includewhich includeoverall past performance of the market seen from a historical perspective, recommendations, advice, and forecasts from professional investors, information from the company as a basis for a fundamental analysis, information from newspapers/TV/magazines, information from the Internet, own intuition of future performance, discussion with personal friends, information from colleagues at work (information) andsmall investors invest different types of derivatives most frequency (types).The specific name given to each factor is designed to reflect an item or notion that conceptually relates to the rest of the items under a particular factor (see table 3).

Table 3.*Varimax-rotated principal component loadings*

		Factor			
Item	A	B	C	Item name	Factor
1	0.867			Experience	A
2	0.838			Age	A
3	0.688			Income	A
4		0.792		Portfolio	B
5		0.711		Average Return	B
6		0.664		Tolerance	B
7		0.558		Expectation	B
8			0.765	Information	C
9			0.664	Types	C

Notes: Factor names are A: Personal Background; B: Return Performance; C: Reference Group.

The reliability test is reported in Table 4. At this point only initial of internal reliability of the expected factors was performed in the form of Cronbach's coefficient α. For the purposes of this study, the cut-off value adopted was 0.5 (Nunnally, 1978) and the acceptable benchmark level of corrected item-total correlation was set above 0.3. Following the decision relating to the internal reliability, the factors were re-specified. This was undertaken to further reduce the number of factors. The internal reliability of the first structure was tested and the decision results provide evidence as to the weakness of the structure since two factors (factor A and B) exceeded the adopted criteria. It is found that factor A contains three items and relates to "personal background"; factor B is made up of four items and refers to "return performance". Factor C comprises two items and deal with "reference group". The derived scales appear to possess moderate to weak internal consistency. So, we eliminated factor C (see Table 4).

Table 4.*Internal consistency and related decisions of first structure*

Factors and items	Corrected item-total correlation	Cronbach's coefficient α value	Decision
Factor A			
(Personal Background)			
Experience	0.6202	0.7160	Retained
Age	0.5605		
Income	0.4820		
Factor B			
(Return performance)			
Portfolio	0.4438	0.5459	Retained
Average Return	0.4168		
Tolerance	0.3677		
Expectation	0.3037		
Factor C (Reference group)			
Information	0.0498	0.0920	Eliminated
Types	0.0498		

To examine possible differences in the perceived importance of three factors, our analyses indicate that out of four criteria (i.e., rotated principal component loadings, scree test, KMO and Bartlett's test of Sphericity, reliability test) examined, only two factors (personal background, return performance) are significant (see table 5).

Table 5. *Internal consistency of final revised structure*

Items	Number of item	Corrected item-total correlation	Cronbach's coefficient α value
Factor A			
(Personal Background)			
Experience	3	0.6202	0.7160
Age		0.5605	
Income		0.4820	
Factor B			
(Return performance)			
Portfolio	4	0.4438	0.5459
Average Return		0.4168	
Tolerance		0.3677	
Expectation		0.3037	

Based on these results, we can derive the following ascending order of importance (reference group is the least important and personal background is the most important):

1. Factor C: Reference group
2. Factor B: Return performance
3. Factor A: Personal background

We create ranking orders of the threedeterminants that are common for all investment decision and respectively for all small investors. To get the determinants ranking orders for each small investor, we should follow ascending order of importance.

The determinantsorder the pure investment decision: [Reference Group, Return Performance, Personal Background] with the following ranking: R_1 = [1, 2, 3].

Table 6. *The set all possible rank orders for N=3, along with their correlation with the "canonical" order 123*

	Rank Orders					
	1	2	3	4	5	6
Small investor	P	Q	R	S	T	U
	1	1	2	2	3	3
	2	3	1	3	1	2
	3	2	3	1	2	1
τ	+1	+0.33	+0.33	-0.33	-0.33	-1

This ranking is different for every small investor. As an illustration, table 6 shows the entire N! = 3 x 2 x 1= 6 possible rank orders for a set of N = 3 determinants along with its value of **τ** with the "canonical order" (i.e., 123). As a result, each small investor has different level of investment decision. We find the Kendall rank correlation coefficients for small investor using initially easy make investment decision ranking order as the standard, and later we will do the same using small investor do not make investment decision or small investor has great difficulty making investment decision ranking order as the standard.

Choice of small investors: Q, T, U

Small investor Q: [ReferenceGroup,Personal Background,Return performance] with the ranking: R_2 = [1, 3, 2].

We are comparing two ordered sets. We should look at the number of different pairs between two sets which allow us to get to something which is called the "symmetric difference distance" between these two sets.

$$\tau = 1 - \frac{2 \times \lfloor d\Delta(P_1, P_2) \rfloor}{N(N-1)}$$

The symmetric difference distance between two sets of ordered pairs P_1 and P_2 is denoted $d_\Delta(P_1, P_2)$. N is number of ranked determinants, in our case N = 3. Kendall coefficient of correlation is obtained by normalizing the symmetric difference such that it will take values between -1 and +1 with -1corresponding to the largest possible distance (equal to -1, obtained when one order is the exact reverse of the other order) and +1 corresponding to the smallest possible distance (equal to +1, obtained when both orders are identical).

The Kendall coefficient of correlation of determinants ranking for the small investor Q and the pureinvestment decision is +0.33:

P_1 = {[1, 2], [1, 3], [2, 3]}.

P_2 = {[1, 3], [1, 2], [3, 2]}.

The set of pairs which are in only one set of ordered pairs is {[2, 3], [3, 2]}. So, the value of $d_\Delta(P_1, P_2)$ = 2. That means that the value of the Kendall rank correlation coefficient between two orders of investment decision is:

$$\tau = 1 - \frac{2 \times 2}{3 \times 2} = +0.33$$

Small investor U: [Personal Background, Return performance, Reference Group] with the ranking: R_3 = [3, 2, 1].

P_1 = {[1, 2], [1, 3], [2, 3]}.

P_3 = {[3, 2], [3, 1], [2, 1]}.

The set of pairs which are in only one set of ordered pairs is {[1, 2], [2, 1], [1, 3], [3, 1], [2, 3], [3, 2]}. So, the value of $d_\Delta(P_1, P_3)$ = 6. That means that the value of the Kendall rank correlation coefficient between two orders of determinants is:

$$\tau = 1 - \frac{2 \times 6}{3 \times 2} = -1$$

Small investor T: [Personal Background, Reference Group, Return performance] with the ranking: R_4 = [3, 1, 2].

P_1 ={[1, 2], [1, 3], [2, 3]}.

P_4 ={[3, 1], [3, 2], [1, 2]}.

The set of pairs which are in only one set of ordered pairs is { [1, 3], [3, 1], [2, 3], [3, 2]}. So, the value of $d_\Delta(P_1, P_4)$ = 4. That means that the value of the Kendall rank correlation coefficient between two orders of determinants is:

$$\tau = 1 - \frac{2 \times 4}{3 \times 2} = -0.33$$

Because the determinants ranking order of small investor do not make investment decision is extremely opposite to the determinants ranking order of small investor makes investment decision easily. The Kendall rank correlation coefficient between them is τ= - 1. Respectively for the above discussed small investors, the Kendall rank correlation coefficients with the no investment decision order would be: +1 for small investorU, +0.33 for small investor T and -0.33 for small investorQ.

We can conclude that small investorQ is the closest to makeinvestment decision easily setting priority and small investorU is the farthest from makeinvestment decision easily among them. Small investor T is relatively great difficulty making investment decision.

5. Conclusion

The primary objective is to investigate the factors, investing characteristics and decision making processes that affect Hong Kong's small investors who participate in derivatives markets.Using factor analysis, we identify three factors that capture the behavior of small investors in the Hong Kongderivatives markets. The factors are reference group, return performance andpersonal background.The factor of reference group includes information and different types of financial derivatives;the factor of return performance includes portfolio, average income, tolerance and expectation; the factor of personal background includes experience, age and income.In order to examine possible differences in the perceived importance of three factors, our analysis indicate that out of four criteria (including rotated minimum residual solution, scree test, KMO and Bartlett's test of Sphericity, and reliability test) examined, only two factors (i.e., personal background,return performance) stand out to be significant. Accordingly, it can be concluded that the behavior of small investorsin the Hong Kong derivatives markets have uniform views as to the ascending order of importance of reference group, return performance and personal background (reference group is the least important and personal background is the most important).

To get the determinants ranking orders for small investor in easy make investment decision, we should follow ascending order of importance. This ranking is different for every small investor. As a result, each small investor has differentranking of factors. We have reported evidence from three small investors (Q, T, U) that the determinants ranking order of small investor do not make investment decision is extremely opposite to the determinants ranking order of small investor makes investment decision easily. The Kendall rank correlation coefficient between them is $\tau = -1$. Respectively for the above discussed small investors, the Kendall rank correlation coefficients with the no investment decision order would be:+1 for small investor U,+0.33 for small investor Tand -0.33 for small investor Q.We can conclude that small investor Q is the closest to make investment decision easily setting priority and small investor U is the farthest from make investment decision easilyamong them. Small investor T is relatively not easy to make investment decision. This implies that financial advisors can approach the customers (small investors) with Kendall rank correlation coefficients greater than zero. These customerswith Kendall rank correlation coefficients greater than zero are relatively easy to make investment decision in the Hong Kong derivatives markets. Based on these findings, more research should be conducted in the future to examine the behavior of small investors in other financial markets.

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