A Selection Method of ETF's Credit Risk Evaluation Indicators*

Ying Zhang ¹, Zongfang Zhou ¹, and Yong Shi ²

¹ School of Management, University of Electronic Science & Technology of China,
P.R. China, 610054

² Research Center on Fictitious Economy & Data Science, CAS, Beijing 100080, China and
College of Information Science and Technology, University of Nebraska at Omaha,
Omaha, NE 68182, U.S.A

zzf1020@yahoo.com.cn, yshi@gucas.ac.cn

Abstract. This work applied data analysis method of attribute reduction to the credit risk evaluation indicators selection of the emerging technical firms (ETF), and constructed the ETF's credit risk evaluation indicators system. Furthermore, the utilization the distinct matrix method was carried out the confirmation to the reduction result. Finally the 7 ETF's data was used to carry out the analysis in the western of China by attribute reduction and their core attribute was obtained.

Keywords: ETF, credit risk, evaluation indicators, attribute reduction.

1 Introduction

The Rough Set theory was proposed by Pawley Z in 1982. In 1991 Pawley Z published a monograph which elaborated the RS theory comprehensively and established a strict mathematical foundation for it. However, there is little information available in literature about the application of attribute reduction method to the research for the credit risk of emerging technology firms.

Our work is thus devoted to adopting the attribute reduction in the ETF's credit risk indicator selection as an application of RS. The work was carried out on reducing the condition attribute of the ETF's credit risk evaluation indicator. Firstly, the credit risk evaluation indicator of the common firms was referenced. Then, in view of ETF, its condition attribute value was separated, and the redundant ingredient was removed by the attribute reduction algorithm. Finally, group of ETF's credit risk evaluation indicator was obtained.

The indicator attributes provide a support for the scientific management, the forecast, and the decision-making for the ETF.

* This research is partially supported by grants from National Natural Science Foundation of China (#70671017, #70621001, #70501030, #70472074), 973 Project #2004CB720103, BHP Billiton Co., Australia.

2 Attribute Reduction

2.1 Data Discretization

This work employed the improved greedy algorithm which does not have the policy-making condition ([1]).

An information system S can be represented as: $S = (U, R, V, F)$. Here, $U = \{x_1, x_2, \dots, x_n\}$ which denotes the universe of discourse is a non-empty limited set. $R = C \cup D$ is the attribute set, subset C and D is called the condition attribute and the policy-making attribute respectively. $V_a \in [l_a, r_a]$ indicates the value territory of attribute a , $l_a = c_1^a < c_2^a < c_3^a \dots < c_n^a = r_a$. $V_a = [c_1^a, c_2^a) \cup [c_2^a, c_3^a) \cup \dots \cup [c_{n-1}^a, c_n^a)$. the $c_1^a, c_2^a, \dots, c_n^a$ are called the breakpoint. The arbitrary breakpoint in V_a is assembled in the interest of $\{(a, c_1^a), (a, c_2^a), \dots, (a, c_n^a)\}$. And for $a, c_i^a \in R$.

Let $S^* = (U^*, R^*, V^*, F^*)$ be a new information system. In it, $U^* = \{(x_i, x_j) \in U \times U\}$, $R^* = \{P_r^a | a \in C\}$. Here, the P_r^a is the r -th breakpoint of a . As for arbitrary P_r^a , in case $(C_r^a, C_{r+1}^a) \subseteq \{\min[a(x_i), a(x_j)], \max[a(x_i), a(x_j)]\}$, $a(x_i)$ expresses the i -th attribute value of a . In that way $P_r^a((x_i, x_j)) = 1$ otherwise $P_r^a((x_i, x_j)) = 0$. $P_r^a((x_i, x_j))$ denotes acting according to the element (x_i, x_j) with the r -th breakpoint substituting of attribute a . Step as follows:

1. Information table S on the basis of former constitutes new information table S^* ;
2. The initial breakpoint set is a empty set;
3. When only one breakpoint the row 1 value integer many, select all rows 1 value integer most breakpoints join to the breakpoint, remove the row and in this breakpoint which this breakpoint is at the value are 1 line; When has above same the breakpoint row 1 value integer, corresponds a row institute the break point row value is 1 line 1 integer adds together, takes is the breakpoint which sum of the line value is smallest.
4. If recent information table is not empty, go to third step, otherwise stop.

2.2 The Attribute Reduction

Information system S can be expressed by $S = (U, R, V, F)$. Here the $F: U \times R \rightarrow V$ denotes a mapping from $U \times R$ to V . Suppose R is a equal in value relational bunch on U , then $\text{IND}(R)$ expressed on U are all equal in value kinds which derives by R .

If $r \in R$ and $\text{IND}(R) = \text{IND}(R - \{r\})$, then r is called in R the condition attribute which can be removed; If $\text{IND}(R) \neq \text{IND}(R - \{r\})$, then r is called the condition attribute which should not drop out from R .

The removable condition attribute in the indicator system is unnecessary if removing them from the indicator system will not change this indicator system in classified ability. On the contrary, if in the indicator system removes the condition attribute which should not be dropped out, then the classified ability of the indicator system will certainly change. If any $r \in R$ is not dropped out from R , then equal value relates bunch of R is independent; otherwise R is related. The condition attribute in which R should not be dropped out is called the core attribute.

In the ordinary status, an information system reduction continues one kind. This reduction has approximately maintained same classification ability to the original condition attribute. The simplification distinct matrix method is introduced for computing the reduction more effectively. Step as follows:

1. The initial data discretization produced the knowledge information table;
2. Observe object whether there is the same attribute condition and can't be distinguished; delete object which has the same attribute condition and cannot be distinguished;
3. Directly pick up the distinct HFS[3] of the first object from the information system to be opposite to other objects, and reduction;
4. Is opposite front in turn the object to other objects withdraws distinct HFS and adds on to be distinct HFS, and reduction;
5. Finally, obtain the reduction of information system.

3 ETF's Credit Risk Evaluation Indicator System

The emerging technology which refers to these recently to appear or to develop, has an important influence on the economic structure or the profession development. The ETF with high degree of concentration manpower, the intelligence and the technological resource complex compound, has the high risk, high incertitude and the high defeat rate characteristic.

In previous literature, the majority concerned emerging technical aspect and so on firm's concept. While management conducted the research to ETF's credit risk research is extremely few. The [6] mainly induced the influence of emerging technology firms credit risk some important characteristics from the system risk and the non- system risk two aspects.

This research is based on the indicator selection systematic characteristic, the scientific nature, may be operational, objective as well as the quota and decides the disposition union the principle, through to the ETF investigation and the analysis, induces from the multitudinous indicator distinguishes between the traditional profession, the prominent characteristic of ETF's credit risk evaluation indicator, it including the profit ability, pays off a debt the ability, the business capacity, the innovation ability and the market competition strength.

Where the profit ability is reflected by the indicator such as transport business profit margin, the total assets reward rate, the net assets income rate, the new product income increase ratio, and the firms goodwill. The pay-off ability of a debt is reflected by the indicator like property debt rate, liquidity ratio, cash current capacity ratio, and Quick assets ratio. The business capacity is reflected by the indicators as the total assets velocity, the account receivable velocity, income rate of increment, the new product sale personnel ratio, the superintendent manage the level. The innovation ability is reflected by the indicators such as the R&D expense accounts for the sales income ratio, researches and develops the personnel ratio, the new equipment rate, master above cultural staff population, invisible asset possessing rate. The firms goodwill is reflected by the indicator like customer quantity, new product life cycle, product strain strength,

new product quantity. The significance of these indicators are different. There inevitably be some relevance and duplication between the indicators.

This work adopts the data analysis method of the attribute reduction and the distinct matrix method, and seeks the simple and effective attribute set. The ETF credit risk evaluation indicator system is constructed as thus.

4 A Demonstration

The case below used 7 ETF's data to carry out the analysis in the western of China, with *A*, *B*, *C*, *D*, *E* and *F* denoted them respectively.

Table 1. The 7 ETF's Data in the Western of China

Indicator	Sub- indicator	<i>A</i>	<i>B</i>	<i>C</i>
Profit Capability	Operation profit margin (%)	23.34	63.64	29.78
	Total assets reward rate (%)	9.71	28.85	12.99
	Net assets income rate (%)	34.23	25.71	12.43
	The new product income increase ratio (%)	10.42	4.35	7.56
	Business goodwill(Ten thousand Yuan)	8.26	3.36	4.52
Pays off a debt the ability	Property debt rate (%)	9.22	34.04	45.82
	liquidity ratio (%)	7.07	8.42	4.34
	Cash flow ratio (%)	21.70	27.05	13.24
	Quick assets ratio (%)	4.23	4.58	2.35
Business capacity	Assets velocity (%)	41.61	44.52	43.62
	Account receivable velocity	5.36	6.89	4.52
	Income rate of increment (%)	-3.22	1.11	-0.16
	New product sale personnel ratio (%)	25.68	45.62	26.35
	The superintendent manages level	3.8	3.25	3.57
Innovation Capability	The R&D expense accounts for the sales income ratio (%)	10.37	9.78	11.25
	Researches and develops the personnel ratio (%)	10.36	6.98	8.45
	New equipment rate (%)	37.49	63.44	29.32
	Above master accounts for the total staff population	20.48	12.61	15.64
	Invisible asset possessing rate (%)	19.7	9.86	24.98

Table 1. (continued)

Market competition strength	Client's amount (hundred million)	2.3	1	1
	New product life cycle (Year)	1	3	3
	Product strain strength	middle	Good	middle
	New produce amount	3	2	2
Indicator	Sub- indicator	<i>D</i>	<i>E</i>	<i>F</i>
Profit Capability	Operation profit margin (%)	34.89	29.20	-28.86
	Total assets reward rate (%)	20.33	16.81	-5.15
	Net assets income rate (%)	14.27	16.42	-5.23
	The new product income increase ratio (%)	8.16	5.42	3.21
	Business goodwill(Ten thousand Yuan)	1.15	1.03	5.09
Pays off a debt the ability	Property debt rate (%)	8.30	8.37	8.37
	liquidity ratio (%)	12.08	11.49	11.35
	Cash flow ratio (%)	17.13	18.02	-4.40
	Quick assets ratio (%)	6.52	5.46	5.36
Business capacity	Assets velocity (%)	59.76	57.56	17.83
	Account receivable velocity	6.92	7.06	3.65
	Income rate of increment (%)	2.67	8.86	-2.32
	New product sale personnel ratio (%)	40.56	30.48	20.31
	The superintendent manages level	4.11	4.00	3.67
Innovation Capability	The R&D expense accounts for the sales income ratio (%)	8.71	2.43	3.56
	Researches and develops the personnel ratio (%)	15.23	5.62	6.83
	New equipment rate (%)	153.82	25.48	115.89
	Above master accounts for the total staff population	30.56	25.68	18.97
	Invisible asset possessing rate (%)	10.24	1.06	3.27
Market competition strength	Client's amount (hundred million)	2.7	0.8	0.76
	New product life cycle (Year)	2	2	2
	Product strain strength	Good	Good	bad
	New produce amount	2	2	3

The attribute reduction was removed through the attribute one by one. The profit ability indicator concreted the reduction operation as follows:

First step: Attribute value discretization. The result is in table 2.

Second step: Delete the redundant attribute condition.

In table 2, new product income increase ratio and the firms goodwill income attribute value quite same not less than, explained their classified ability is same, deletes a attribute condition not to affect the classified result, deletes the firms goodwill income attribute.

Third step: Attribute value reduction.

Universe of discourse $U = \{A, B, C, D, E, F\}$, attribute condition set $R = \{a, b, c, d, e\}$; $IND(R) = \{\{A\} \{B\} \{C\} \{D\} \{E\} \{F\}\}$, $IND(R - \{a\}) = \{\{A\} \{B, E\} \{C\} \{D\} \{F\}\} \neq IND(R)$. The attribute a was removed to change the information table classified ability. Therefore attribute a is the core attribute which cannot be dropt out.

Table 2. The Result of Discretization

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
Operation profit margin <i>a</i>	1	2	1	2	1	1
Assets remuneration ratio <i>b</i>	1	2	1	2	2	1
Net assets income rate <i>c</i>	2	2	1	1	2	1
New produce income seizes increase ratio <i>d</i>	2	2	2	1	2	1
Business goodwill <i>e</i>	2	2	2	1	2	1

Table 3. The Deleting Result of the Redundant Attribute Condition

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
Operation profit margin <i>a</i>	1	2	1	2	1	1
Assets remuneration ratio <i>b</i>	1	2	1	2	2	1
Net assets income rate <i>c</i>	2	2	1	1	2	1
New produce income seizes increase ratio <i>d</i>	2	2	2	1	2	1

According to that $U = \{A, B, C, D, E, F\}$ is attribute condition set $R = \{a, b, c, d, e\}$, $IND(R) = \{\{A\} \{B\} \{C\} \{D\} \{E\} \{F\}\}$, $IND(R - \{a\}) = \{\{A\} \{B, E\} \{C\} \{D\} \{F\}\} \neq IND(R)$. Getting rid of attribute a revised the information table classification capability. The same principle may result in $IND(R - \{b\}) = \{\{A, E\} \{B\} \{C\} \{D\} \{F\}\} \neq IND(R)$. Here b is the core attribute which cannot be dropt out. $IND(R - \{c\}) = \{\{A, C\} \{B\} \{D\} \{E\} \{F\}\} \neq IND(R)$, c also can not be dropt out. $IND(R - \{d\}) = \{\{A\} \{B\} \{C, F\} \{D\} \{E\}\} \neq IND(R)$, d is also the core attribute, and the profit capability core attribute set is $\{a, b, c, d\}$.

Using the distinct matrix to the profit ability carries on attribute reduction resulted the same and confirmed the above method results.

Utilizing the method above to the business capacity, the innovation ability and the market competition strength separately carried out attribute reduction. Finally their core attribute was obtained.

The business capacity including the total assets velocity, the account receivable velocity, the superintendent manages level; the innovation ability accounts for the sales income ratio including the R&D expense, researches and develops the personnel ratio, the new equipment rate, invisible asset possessing rate; market competition strength including customer quantity, new product life cycle, product strain strength.

5 Concluding

This article proposed an attribute reduction method for ETF's credit risk evaluation indicator. Besides, a simplification and exercisable evaluation indicator system which respond the credit characteristic of ETF was obtained. It can be effectively employed by evaluation the credit risk of the ETF scientifically.

References

1. Wang, G.: Rough's set theory and knowledge acquisition [M]. Xian Jiao tong University Press (2001)
2. Han, Z., Zhang, F., Wen, F.: Summarize of the Rough's set theory with its applications [J]. Control Theory with Application 16 (1999)
3. Liu, Q.: Rough's theory and Rough consequence. Scientific Press [M] (2001)
4. Zhang, W., Wu, W.: Introduction of Rough's theory and research summarize [J]. Fuzzy System and Mathematics (14) (2000)
5. Shi, X.: Theory and means of credit evaluation [M]. The Administered and Economy Press (2002)
6. Chen, L., Zhou, Z.F.: To Analyze Risks of Credit for Enterprises of New Technique on the Internet Development from among the China [J]. Value Engineering (4) (2005)
7. Zhang, Y., Zhou, Z.: Commercial bank credit risk evaluation index entropy power choice method [J]. Journal of University of Electronic Science and Technology of China 35(5), 857–860 (2006)
8. Zhang, Y., Zhou, Z.: Based on fuzzy entropy commercial bank credit risk evaluation index choice method [J]. Management Review 18(7), 27–31 (2006)