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Assessment on investment risk of venture capital project with linguistic information

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ABSTRACT

With the development of high-new technology industries and the coming of information economy, venture capital emerges as the times requires and has been rapidly fashionable all over the world. Today, in the fast development of information economy, venture capital plays an important part in accelerating innovation of science and technology, improving productivity, adjusting industry structure, advancing the integrated national power and international contest ability. In venture capital practice activities, evaluating the projects correctly is an essential link to make the venture capital operate successfully. In this paper, we investigate the multiple attribute group decision making (MAGDM) problems for evaluating the investment risk of venture capital project with linguistic information. We utilize the linguistic weighted averaging (LWA) operator and linguistic hybrid aggregation (LHA) operator for evaluating the investment risk of venture capital project with linguistic information. Finally, an illustrative example is given to verify the developed approach and to demonstrate its practicality and effectiveness.

KEYWORDS

Evaluation; Linguistic Information; Linguistic Weighted Averaging (LWA) Operator; Linguistic hybrid aggregation (LHA) operator; Investment risk of venture capital project.

INTRODUCTION

Venture capital as an intelligent investment, on behalf of the funds and a combination of knowledge and ideas, coagulates a unique wisdom of its own in its investment process. Since venture capital develops so far from its establishment, its role has far beyond its original scope. The tentacles of its activities deepen into clean energy, telecommunications, pharmaceutical, aerospace and other fields. Incubator has played a pivotal role in society through its successful technology. With the rapid economic development and highly developed financial market, the perfect integration, investment in huge profits for the further development of venture capital creates a wider space. The country have been introduced strengthen risk investment in the development of specific support policies, which to some extent, gives more promotion effect to the venture capital industry, its prosperity and development. Venture capital has its own unique attributes. As its investment process faces many risks, the decision-making process of venture capital is subject to a variety of factors and constraints. Hence making an accurate investment projects and appropriate evaluation plays a decisive role in the success of its final investment projects. So the decision-making of venture capital is particularly important in the investment project. At this stage, the research on venture capital has become a research focus at home and abroad. Theory and Practice of innovation greatly promoted its improvement and development, but the research on assessment of venture capital is oriented, trivial and lack of integrity. The development and growth of venture capital industry are depended on a perfect assessment system and correct decision-making method. Venture capitalist's reasonable and correct decision-making influences the overall revenue of venture capital firms in a large extent. However, there are many defects in the domestic investment projects' assessment and decision-making both in the theoretical researches and applications at present, such as the simple in the decision-making of prior assessment, the formalization in the decision-making of operation, the blank in the decision-making of abandon assessment. The study on venture capitalists' decision-making process is still in the stage of experience management whether in theory or practice, and it lacks a relatively perfect system and a sound method. The lag of the research on the venture capital's decision-making has seriously hampered the development of venture capital, and the development of venture capital practice need the advice of venture capital theory.

Venture Capital is an equity investment behavior that the venture corporations invest in high-tech project along with companies, and take part in venture business' management and operation to get high profit from the capital. The appraisal of project plays an important part in the process of Venture Capital, and it relatively objectively reflects the value and potential of the venture business, which offers a valuable basis for the final decision. Yan[1] investigated the multiple attribute decision making (MADM) problems for evaluating the risk of marketing with hesitant fuzzy information which utilized the hesitant fuzzy choquet ordered averaging (HFCOA) operator to aggregate the hesitant fuzzy information corresponding to each alternative and get the overall value of the risk of marketing, then rank the venture capital project and select the most desirable one (s) by using the score functions of hesitant fuzzy values. Lu et al.[2] adopted Analytic Hierarchy Process (AHP) and fuzzy comprehensive evaluation methods to evaluate venture capital project, The empirical analysis shows that the model is feasible. It showed that entrepreneurs characteristics and exit are the most important factors of project appraisal in China. The model gives some reference to venture capital firm.

In this paper, we investigate the multiple attribute group decision making (MAGDM) problems for evaluating the investment risk of venture capital project with linguistic information. We utilize the linguistic weighted averaging (LWA) operator and linguistic hybrid aggregation (LHA) operator for evaluating the investment risk of venture capital project with linguistic information. Finally, an illustrative example is given to verify the developed approach and to demonstrate its practicality and effectiveness.

PRELIMINARIES

Let $S=\{s_i \mid i=0,1,\cdots,t\}$ be a linguistic term set with odd cardinality. Any label, s_i represents a possible value for a linguistic variable, and it should satisfy the following characteristics[3-5]:①The set is ordered: $s_i > s_j$, if $i > j$; ②There is the negation operator: $neg(s_i)=s_j$ such that $j=t-i$. For example, S can be defined as[6-10]

$$S=\{s_0=extremely\ poor, s_1=very\ poor, s_2=poor, s_3=medium,$$
$$s_4=good, s_5=very\ good, s_6=extremely\ good\}$$

Definition 1[11]. A linguistic ordered weighted geometric (LWA) operator of dimension n is a mapping LWA: $\overline{S}_n \to S_n$, which has associated with it an exponential weighting vector $\omega=(\omega_1,\omega_2,\cdots,\omega_n)^T$, with $\omega_j \in [0,1]$ and $\sum_{j=1}^{n}\omega_j=1$, such that:

$$\mathrm{LWA}_{\omega}(s_{\alpha_1},s_{\alpha_2},\cdots,s_{\alpha_n})=\omega_1\otimes s_{\alpha_1}\oplus\omega_2\otimes s_{\alpha_2}\oplus\cdots\oplus\omega_n\otimes s_{\alpha_n} \quad (1)$$

Definition 2[11]. Let $s_{\alpha_i}(i=1,2,\cdots,n)$ be a linguistic terms sets, and

$$\mathrm{LOWA}_{w}(s_{\alpha_1},s_{\alpha_2},\cdots,s_{\alpha_n})=w_1s_{\beta_1}\oplus w_2s_{\beta_2}\oplus\cdots\oplus w_ns_{\beta_n} \quad (2)$$

where $w=(w_1,w_2,\cdots,w_n)$ is the associated weighting vector, with $w_j\in[0,1]$, $\sum_{j=1}^{n}w_j=1$, and s_{β_j} is the j-th largest element in the linguistic variables set $(s_{\alpha_1},s_{\alpha_2},\cdots,s_{\alpha_n})$, then the function LOWA is called the linguistic ordered weighted averaging (LOWA) operator of dimension n.

Definition 3[11]. Let $s_i(i=1,2,\cdots,n)$ be a linguistic terms sets, and

$$\mathrm{LHA}_{w,\omega}(s_1,s_2,\cdots,s_n)=w_1\times r_1\oplus w_2\times r_2\oplus\cdots\oplus w_n\times r_n=\overset{n}{\underset{i=1}{\oplus}}w_i\times r_i \quad (3)$$

where $w=(w_1,w_2,\cdots,w_n)$ is the associated weighting vector, with $w_j\in[0,1]$, $\sum_{j=1}^{n}w_j=1$, and r_i is the i-th largest element of the linguistic weighted argument $r_i'(r_i'=n\omega_i s_i)$, $\omega=(\omega_1,\omega_2,\cdots,\omega_n)$ is the weighting vector of linguistic variables $s_i(i=1,2,\cdots,n)$, with $\omega_i\in[0,1]$, $\sum_{i=1}^{n}\omega_i=1$, and n is the balancing coefficient, then the function LHA is called the linguistic hybrid aggregation (LHA) operator of dimension n.

ASSESSMENT ON INVESTMENT RISK OF VENTURE CAPITAL PROJECT WITH LINGUISTIC INFORMATION

In this section, we consider a multiple attribute group decision making problems to evaluate investment risk of venture capital project with linguistic information. Let $A=\{A_1,A_2,\cdots,A_m\}$ be a discrete set of alternatives, and $G=\{G_1,G_2,\cdots,G_n\}$ be the set of attributes, $\omega=(\omega_1,\omega_2,\cdots,\omega_n)$ is the

exponential weighting vector of the attributes $G_j\ (j=1,2,\cdots,n)$, where $\omega_j \in [0,1], \sum_{j=1}^{n} \omega_j = 1$. Let $D=\{D_1, D_2, \cdots, D_t\}$ be the set of decision makers, and $\nu=(\nu_1,\nu_2,\cdots,\nu_t)$ be the weight vector of decision makers, where $\nu_k \in [0,1], \sum_{k=1}^{t} \nu_k = 1$. Suppose that $R_k = \left(r_{ij}^{(k)}\right)_{m\times n}$ is the decision matrix, where $r_{ij}^{(k)} \in S$ is a preference value, which takes the form of linguistic variables, given by the decision maker $D_k \in D$, for the alternative $A_i \in A$ with respect to the attribute $G_j \in G$.

In the following, we apply the LWA and LHA operators to MAGDM problems for evaluating investment risk of venture capital project with linguistic information.

Step 1**.** Utilize the decision information given in matrix R_k, and the LWA operator

$$r_i^{(k)} = \mathrm{LWA}_{\omega}\left(r_{i1}^{(k)}, r_{i2}^{(k)}, \cdots, r_{in}^{(k)}\right), i=1,2,\cdots,m, k=1,2,\cdots,t. \tag{4}$$

to derive the individual overall preference value $\tilde{r}_i^{(k)}$ of the alternative A_i.

Step 2**.** Utilize the LHA operator:

$$r_i = \mathrm{LHA}_{\nu,w}\left(r_i^{(1)}, r_i^{(2)}, \cdots, r_i^{(t)}\right), i=1,2,\cdots,m \tag{5}$$

to derive the collective overall preference values $\tilde{r}_i\ (i=1,2,\cdots,m)$ of the alternative A_i, where $\nu=(\nu_1,\nu_2,\cdots,\nu_n)$ be the weight vector of decision makers, with $\nu_k \in [0,1]$, $\sum_{k=1}^{t} \nu_k = 1$, $w=(w_1,w_2,\cdots,w_t)$ is the associated weighting vector of the LHA operator, with $w_k \in [0,1]$, $\sum_{k=1}^{t} w_k = 1$.

Step 3**.** Rank all the alternatives $A_i\ (i=1,2,\cdots,m)$ and select the best one (s) in accordance with $r_i\ (i=1,2,\cdots,m)$.

NUMERICAL EXAMPLE

Venture capital is a form of investment that a special investment institution raises venture capital from various agencies and individuals through a certain way, and then invests the raised capital with the form of the stock equity in enterprises or projects with a high degree of uncertainty, and participates in the management of the enterprises or projects in order to achieve high growth rates of the project and ultimately achieve high capital benefits by the stock equity on sale. Because it accelerates the transformation of scientific and technological achievements and plays a special role in promoting the development of high-tech industries, it pays increasingly attention. In the 21st century of knowledge economy and economic globalization, intensive study on the theoretical and practical problem of China's venture capital has greatly practical significance and importantly theoretical value for raising the international competitiveness of China's economy and achieving the overall revitalization of Chinese nation in the 21st century. In recent years, venture capital is a hot topic in economic and financial theory in China and the research results are fruitful. In this section, we present an empirical case study of evaluating the investment risk of venture capital project with linguistic information. Assume that an enterprise newly identified an investment with five projects, and in order to evaluate the venture capital investing project based on high-tech outcome transformation, we need to determine the risk factor of the five projects so as to choose the optimal one. The investment company must take a decision according to the following four attributes: G_1 is the outcome's risk; G_2 is the environment risk; G_3 is the financing risk; G_4 is the technological risk; G_5 is the marketable risk; G_6 is the management risk; G_7 is the

cooperative risk. The five possible venture capital projects $A_i\left(i=1,2,3,4,5\right)$ are to be evaluated using the linguistic term set S by the three decision makers $D_k\left(k=1,2,3\right)$ (whose weighting vector $\nu=\left(0.20,0.50,0.30\right)$) under the above four attributes (whose weighting vector $\omega=\left(0.20,0.30,0.40,0.10\right)$), and construct, respectively, the decision matrices as follows $R_k=\left(r_{ij}^{(k)}\right)_{5\times4}\left(k=1,2,3,4\right)$:

$$R_1=\begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \end{array}\begin{array}{c} \begin{array}{cccc} G_1 & G_2 & G_3 & G_4 \end{array} \\ \begin{pmatrix} s_4 & s_5 & s_6 & s_5 \\ s_5 & s_4 & s_3 & s_3 \\ s_1 & s_3 & s_5 & s_3 \\ s_3 & s_4 & s_4 & s_4 \\ s_2 & s_4 & s_4 & s_5 \end{pmatrix} \end{array}$$

$$R_2=\begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \end{array}\begin{array}{c} \begin{array}{cccc} G_1 & G_2 & G_3 & G_4 \end{array} \\ \begin{pmatrix} s_5 & s_6 & s_2 & s_4 \\ s_6 & s_3 & s_4 & s_5 \\ s_4 & s_2 & s_6 & s_6 \\ s_2 & s_5 & s_3 & s_4 \\ s_3 & s_6 & s_3 & s_3 \end{pmatrix} \end{array}$$

$$R_3=\begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \end{array}\begin{array}{c} \begin{array}{cccc} G_1 & G_2 & G_3 & G_4 \end{array} \\ \begin{pmatrix} s_5 & s_6 & s_2 & s_3 \\ s_4 & s_3 & s_6 & s_5 \\ s_2 & s_1 & s_6 & s_5 \\ s_4 & s_5 & s_6 & s_3 \\ s_1 & s_3 & s_4 & s_6 \end{pmatrix} \end{array}$$

To get the most desirable investment risk of venture capital project of five possible cities, the following steps are involved:

Step 1**.** Utilize the decision information given in matrix $\tilde{R}_k$, and the LWA operator, we get

$r_1^{(1)}=s_{4.45}, r_2^{(1)}=s_{5.23}, r_3^{(1)}=s_{3.87}, r_4^{(1)}=s_{5.09}, r_5^{(1)}=s_{2.67}$

$r_1^{(2)}=s_{4.09}, r_2^{(2)}=s_{4.78}, r_3^{(2)}=s_{5.89}, r_4^{(2)}=s_{3.21}, r_5^{(2)}=s_{4.90}$

$r_1^{(3)}=s_{3.09}, r_2^{(3)}=s_{4.67}, r_3^{(3)}=s_{5.43}, r_4^{(3)}=s_{4.85}, r_5^{(3)}=s_{4.07}$

Step 2**.** Utilize the LHA operator to derive the values $r_i\left(i=1,2,3,4\right)$ of the investment risk of venture capital project of the city A_i, where $v=\left(0.20,0.50,0.30\right)$ and $w=\left(0.30,0.40,0.30\right)$

$r_1=s_{5.78}, r_2=s_{6.53}, r_3=s_{7.94}, r_4=s_{6.34}, r_5=s_{5.41}$

Step 3**.** Rank all the investment risk of five possible venture capital projects $A_i\left(i=1,2,3,4,5\right)$ in accordance with the values $r_i\left(i=1,2,3,4,5\right): A_3 \succ A_2 \succ A_4 \succ A_1 \succ A_5$. Thus the most desirable venture capital project is A_3.

CONCLUSION

Venture Capital is an equity investment behavior that the venture corporations invest in high-tech project along with companies, and take part in venture business' management and operation to get high profit from the capital. The appraisal of project plays an important part in the process of Venture Capital, and it relatively objectively reflects the value and potential of the venture business, which offers a valuable basis for the final decision. With the development of high-new technology industries and the coming of information economy, venture capital emerges as the times requires and has been rapidly fashionable all over the world. Today, in the fast development of information economy, venture capital plays an important part in accelerating innovation of science and technology, improving productivity, adjusting industry structure, advancing the integrated national power and international contest ability. In venture capital practice activities, evaluating the projects correctly is an essential link to make the venture capital operate successfully. In this paper, we investigate the multiple attribute group decision making (MAGDM) problems for evaluating the investment risk of venture capital project with linguistic information. We utilize the linguistic weighted averaging (LWA) operator and linguistic hybrid aggregation (LHA) operator for evaluating the investment risk of venture capital project with linguistic information. Finally, an illustrative example is given to verify the developed approach and to demonstrate its practicality and effectiveness.

Conflict of interests

The authors declare that there is no conflict of interests regarding the publication of this article.

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