Venture capital investment selection based on promethee

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Abstract:
New developments in today world have formed a new kind of economy different from that in the past. This economy is based on knowledge and it needs new methods of financial provision. Since there is a high risk in the success of these projects (Entrepreneurship projects based on knowledge and technology), they should be investigated well. Then, those projects having high potentiality of profitability and service providing for the society will be selected. Thus, it is necessary to make an organized system for selecting investment projects. This article aims to present a framework for the evaluation of investment projects. In this framework, not only project processes but also different evaluation processes are determined. In addition, corresponding criteria for each evaluation stage are determined. Finally, the problem is solved through PROMETHEE method. For measuring each index, Entropy method is used.

Keywords: PROMETHEE, Venture capital, investment selection

1. Introduction
Following fundamental changes in the structures of economy and industry, new generations of financial centers and organs are forming that are able to help knowledge-oriented and technology-based economy which is not based on tools and cheap workforces. Such an economy is based on intelligent and smart workforces. The heart and engine of this knowledge-based economy is entrepreneurs and those having new ideas. Entrepreneurs are those who change an idea to a product or a service. Entrepreneurs themselves often have new ideas.
One of the most infrastructural problems that these people are facing with is providing money for establishing new business and changing process of knowledge to product (science-practice cycle). Traditional financial provision like loans and loan-giving centers i.e. banks are not able enough to help these projects since they prefer more secure with less risk projects. Venture capital firms are passive interactional systems for these kinds of investments. Such organs provide not only required resources but also full management and advisory supports for entrepreneurs.
Venture capital firms are not formed in gap and their formation and survival require suitable opportunities. The real nature of the venture capital firms and also private equity capitals are formed through purchasing some parts of the firm’s or company’s share. It is clearly different from loans, though it is clear that some loans are changed to shares though. The success of risk-taking investors is in their prediction of their investment increase in the process of the firm development and progress. The assets of the small and newly-formed firms are mainly intelligent human forces rather than fixed physical properties. Therefore, in case of Bankruptcy, nothing significant will remain for covering the costs of investors. That is where the role of venture capital gets completely clear which can prevent the bankruptcy of so many small companies leading to their innovations.
Venture capital invests in newly-established companies which are believed to have revenue ten times more in less than 5 years. Such capital is not interested in those first that have no progress and revenue. The reason is clear since such a capital itself is based on profitability. It should be said that these firms do not evaluate their investment based on the social goals like reducing unemployment, increasing R & D projects, or extending the country’s taxation bases.

2. Literature review
The application of MCDM in the articles related to venture capital has been so littlie. Most research in this filed having a complex concepts have carried out in quality works, for quantity works issues like capital outflow and more investigating methods and techniques have been studied rather than selection and decision. Thus,
scientific sources are few in this field. It should be said that the application of MCDM in financial literature review is more practical in the selection of investment particularly in share portfolio. Few studies have done so far which are mentioned in the following.

Lisen categorized the studies done in venture capital in two groups: 1) the studies which focus on the explanations of executive issues of investment. 2) the studies which focus on the selection, structure, and management of the capital. [11] Kung and Ven investigated the financial performance of venture capital firms in Taiwan by the GRA method. [4] Among all published articles, two of articles of Xubo zhang have evaluated investing of venture capital firms by two methods.

In article, Xubo zhang studied selection of venture capital where by the use of Fuzzy decision making-methods, the desired investment is selected. The researcher tried to select at least one investment plan. The researcher considered five evaluation indexes at the first level where those five indexes have the second level too so totally 18 sub-indexes are evaluated. The evaluation is the distance to the best and worst result. Indeed, the base for decision-making is the logic of the establishment. [13] In another article, Xubo zhang also studied the selection of venture capital. The only difference in this study is that another kind of the MCDM, called Grey Relational Theory, was applied. The selection indexes are the same with the previous article. [13]

The main methods used in MCDM are WSM, WPM, AHP, PROMETHEE, ELECTRE, CP, MATU, TOPSIS. Research has shown the most popular ones have been AHP, PROMETHEE, and ELECTRE. [1]

In a comparison among the mentioned methods focusing on the hierarchy and PROMETHE methods, it was clear that the limitation of the hierarchy analysis to the indexes from 1 to 9 in all processes, a significant number of required operations in the bilateral comparison (this is really true regarding this issue due to the high number of evaluation assessment where their bilateral comparison is too much increasing the error possibility) finally time calculation on the resistance level the accuracy of the output against error used in the hierarchy method, which is done automatically in the PROMETHE method, are considered as the weaknesses of the former method against the later [5]

The selection of a suitable MCDM method for all applications is itself a MCDM proves. Raju and Pillai have differently compared the methods. In their article, consistency, efficiency, confidentiality, robustness are equally selected for the evaluation of the decision-making methods. Finally, CP, ELECTRE, PROMETHEE, and AHP are respectively considered in terms of importance. It is really important here that the point difference between the ELECTRE and PROMETHEE level is so small. The application of CP is known only in suitable conditions where an ideal point is determined as the system goal so finding the closet point to it is the goal. Raju and Pillai mentioned that the ELECTRE method has two weaknesses comparing with the PROMETHEE method. This method in its comparison for the two options accepts one and deletes the other and the final list is presented just by deleting undesirable options without considering the desirability of the presented options. [6] So far, many studies have been done to compare the MCDM techniques in different subjects where each technique has its own advantages and disadvantages and none of them is significantly dominant over the others. The issue under study will determines the priority and efficiency of each method. Research has shown that among MCDM techniques, the hierarchy and PROMETHEE methods are more valid and popular [1]

3. The selection process of venture capital projects

The indexes of selection process of venture capital projects are determined here. These indexes are evaluated for all projects. In each project, each index has some points which are shown in a Matrix.

A venture capital is a capital which together with management supports (marketing, advice, experts, etc.) is given to the newly-established, small firms having rapid progress and economic future. Venture capital is among the most important financial provisions given to the small and new firms. Professional venture capital firms are often companies or cooperatives whose financial sources are provided by retirement funds, foundations, companies, wealthy, foreign investors, or the founders. These firms do not try to get continuous and current income for their investments; if the firm is profitable, the investment profit is made through selling its ownership shares. Ross defined venture capital as: financial provision for newly-build and young firms trying to have a rapid progress [16].

The members and experts of these funds have specialty in different industries including: finance, technology, Entrepreneurship, law, and accounting. [1]
In a broader aspect, venture capital firms are a section of a bigger section called private equity. Such a categorization is not fixed in all issues but it is more common in the USA which has an old history in this industry. In the reports of other VC communities of the world, these two are not separated from each other. It should be mentioned that venture capital is older than private capital.

**Swing weighting method:**

The levels of this method are:

The first level:
The maximum and minimum levels are preferred for each index by the decision maker and two vectors are made.

The second level:
It is assumed that all indexes are preferred in the minimum level, the decision maker is required to select an index for its improvement to the maximum level. (If the improvement is possible for the index, so the most important index is selected by the decision maker)
The index selection is done one by one which continues for each index till the time all index ranking get determined.

The third level:
An optional value for example 100 is given to the goal as the first ranking. (the first index selected to be improved to the maximum level while other indexes are in the minimum level). Then, the decision maker is asked to give a value in terms of 100 percent to each index in their hierarchy meaning that based on the improvement made from the minimum to the maximum.

The forth level:
The gained weights should be normalized in a way that their sum gets one. This level of Algorithm is not needed to be operated since to the last level all gained points are simple in the weight sum method which can be compared with each other. In the mentioned table, the sum of these normal measures is also seen. Since in this level, besides the total points the individual point of each index is highly important, it is needed that in all projects an acceptable point for each index be considered. After comparing all projects with the point of each index, the total evaluation point at the primary level should also be determined and the total point also be considered. For this aim, SAW is applied and the gathered number for the projects in which each index has points is compared with the above basis number.

PROMETHEE is one of the recent MCDM which was developed in 1982 by BRANS and then by BRANS and VINCKE in 1985. This method is of the non-hierarchy method used for a limited set of options and indexes which have interference with each other. The base of this method is bilateral comparison among options. The options are evaluated based on different indexes some of which should be minimized and some maximized.

**Preference function:**

The hierarchy function for each index shows that what hierarchy is considered by the decision maker for the option a against option b. the hierarchy function for each index changes the numerical difference of the two options to a number between zero and one. For this aim, Brans and Vincke have suggested 6 kinds of the main preference functions which are listed in the below table: [6]
The threshold of indifference and preference

Except the basis data needed for the decision-making matrix, more information is needed from the decision makers. Indeed, the decision makers input the preference and their possibility with the definition of the difference threshold \( (q_j) \) and the preference threshold \( (p_j) \) in the process of decision making. These parameters will indicate the acceptable limit for the evaluation of the mentioned indexes. If the difference between the two options a-b in one index is lower than the indifference threshold, the two options have no difference in that index. If the difference between the two options a-b in one index is higher than the preference threshold, the a option is definably better. [6]

4. Proposed model

Imagine A is a set of options which should be selected. If K is as a the influential index in decision making for each a option, then

\[ f_j(a) \] will show the value of the \( j \) index in the a option. hiearchy is made in three steps.

The first step: the

\[ p_j \] is designated to each \( j \) index. \( P_j(a, b) \) is calculated for the pair of the option.

It is different between zero and one. If \( f_j(a) = f_j(b) \), \( P_j(a, b) \) will be zero and with the increase in \( f_j(a) - f_j(b) \), it will also increase. When the difference is big enough, \( P_j(a, b) \) will reach to one.

The second step: the total hierarchy for \( \pi(a, b) \) for each a option is calculated on b option. The higher \( \pi(a, b) \), the a option has higher preference. \( \pi(a, b) \) is calculated in the following way:

\[
\pi(a,b) = \sum_{j=1}^{k} W_j H_j ; \quad H_j = P_j(a,b)
\]
The third step: \( \pi(a, b) \) shows the hierarchy of a comparing with b. To calculate the total preference of a against other options, the output flow is calculated:

The preference of a against other options

\[
\forall x \in a, \quad \varphi^+ = \frac{1}{n-1} \sum_{i=1}^{k} \pi(a, x)
\]

This shows how a is preferred than other options which indeed shows the power of a option.

The preference of other options comparing with a option called input flow is calculated as below:

The preference of other options against a

\[
\forall x \in a, \quad \varphi^- = \frac{1}{n-1} \sum \pi(x, a)
\]

This shows that how other options have preference against a. indeed, it shows the weakness of a option. The amount of the total flow is calculated from the positive and negative flows:

The sum of the total flow

\[
\forall x \in a, \quad \varphi(x) = \varphi^+(x) - \varphi^-(x)
\]

This is the result of balancing the positive and negative flow hierarchy.

5. Evaluation

Evaluation is one of the most important issues in a commercial and financial unit in selecting various capitals since a wrong selection wastes time and investment. Due to the nature of the venture capital projects, this issue is more critical. If something wrong happens in the selection of projects, due to the long-term investment of these, they will surely face with failure. According to statics in the USA, out of 400 projects, 10 are selected for investment and among them only two will be profitable.

An evaluation framework has been proposed for project investments where the evaluation is divided into two primary and precise kinds. Primary evaluation is a kind of sieving of the projects. Normally, 85 of the projects are rejected based on the global economy. Out of these 85 %, 50 % in the primary and 35 % in the risk evaluation are rejected. After primary evaluation, precise evaluation happens which itself has two kinds namely precise financial evaluation and precise management evaluation. Precise financial evaluation usually happens in trade projects while precise management evaluation happens during meetings with the owners of the professions and ideas. Different countries have different approaches for evaluation. For example, in the US and England, management evaluation is emphasized while in France and Belgium, financial management is more important.

Venture capital decision-making evaluation factors

For decision making, the first step after determining the issue is precise recognition of the influential factors on decision making. The following table shows the indexes of evaluation.

<table>
<thead>
<tr>
<th>First assessment indicator</th>
<th>Secondary assessment indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td>Possible early exit from the investment</td>
</tr>
<tr>
<td></td>
<td>Amount of investment</td>
</tr>
<tr>
<td></td>
<td>The accuracy of the estimate</td>
</tr>
<tr>
<td></td>
<td>Ensure Profitability</td>
</tr>
<tr>
<td></td>
<td>Risks accrued on investment</td>
</tr>
<tr>
<td></td>
<td>Unique investment opportunity</td>
</tr>
<tr>
<td>Product</td>
<td>The nature of innovation</td>
</tr>
<tr>
<td></td>
<td>Technology-driven product</td>
</tr>
<tr>
<td></td>
<td>Capable of mass production</td>
</tr>
<tr>
<td>Risk of investment plan</td>
<td>Substitute products</td>
</tr>
<tr>
<td></td>
<td>Exit Opportunities</td>
</tr>
<tr>
<td></td>
<td>Liquidity risk</td>
</tr>
<tr>
<td></td>
<td>Foreign Currency Risk</td>
</tr>
<tr>
<td></td>
<td>Construction of complex products</td>
</tr>
<tr>
<td></td>
<td>Maintenance problems</td>
</tr>
<tr>
<td></td>
<td>Access to skilled labor</td>
</tr>
</tbody>
</table>

570
Risk of failure in competition
Changes in government policies
Access to raw materials
Legal obstacles

The reliability of the entrepreneur
Experience
Communicating with individuals and key reference
Specialty entrepreneurs, management teams and Advice

Analysis of working capital
Quality of assets
Assessment Debt
Salaries and employee benefits
Non-current financial assets
Pricing method is proportional to the product
Net Income
Liquidity

6. Example

Four evaluation projects are considered here in which the criteria are evaluated by experts (decision makers of the venture capital fund) and the results are listed in the table. It should be said that evaluation in the first level of criteria includes the evaluation of the second level.

\[
A = \begin{bmatrix}
3.72 & 4.52 & 3.61 & 4.83 & 3.96 \\
4.01 & 4.13 & 3.89 & 4.27 & 3.45 \\
3.67 & 4.88 & 4.00 & 4.16 & 3.58 \\
3.94 & 4.59 & 4.14 & 4.51 & 3.76 
\end{bmatrix}
\]

In this level, after determining the evaluation matrix, weights are determined based on Entropy method. Thus, the weights of each index are expressed.

\[
w = (0.104, 0.261, 0.186, 0.247, 0.201)
\]

It shows that capital has the minimum and product has the maximum weight. Therefore, in the evaluation of the investment projects, the quality of the product is critical. Generally, the weights are near to each other.

Table 3. Types of preference functions for attribute

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Preference functions</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>preference functions</td>
<td>Level</td>
<td>U shape</td>
<td>U shape</td>
<td>U shape</td>
<td>V shape with indifference</td>
</tr>
<tr>
<td>P</td>
<td></td>
<td>0.1</td>
<td>0.2</td>
<td>0.1</td>
<td>0.15</td>
<td>0.05</td>
</tr>
<tr>
<td>Q</td>
<td></td>
<td>0.15</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.1</td>
</tr>
</tbody>
</table>

After this, a PROMETHEE method is used for finding solution, for each group of evaluation indexes, a suitable evaluation function is selected. The following table shows the functions for each index.

Based on the determined functions, the results are presented.

Table 5. Net flow

<table>
<thead>
<tr>
<th>Plan</th>
<th>(\Phi^+)</th>
<th>(\Phi^-)</th>
<th>(\Phi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan1</td>
<td>0.7270</td>
<td>0.2555</td>
<td>0.4715</td>
</tr>
<tr>
<td>Plan2</td>
<td>0.4702</td>
<td>0.4252</td>
<td>0.0449</td>
</tr>
<tr>
<td>Plan3</td>
<td>0.4225</td>
<td>0.4494</td>
<td>-0.0268</td>
</tr>
<tr>
<td>Plan4</td>
<td>0.1476</td>
<td>0.6372</td>
<td>-0.4896</td>
</tr>
</tbody>
</table>

It is clear that the project order is in a way that the forth options is the best and the second option is the weakest one. It should be said that in this evaluation no difference is seen between a hierarchy done with the 1 PROMETHEE and 2 PROMETHEE. The following figure shows it clearly.
7. Conclusion

The application of a complete evaluation system can lead to the efficient decisions with the use of experts’ ideas and application of math techniques. If an appropriate evaluation is done from the projects of banks, investment funds etc. especially venture capital funds, it is possible not only reduce the risk but also reach to the maximum profitability. After selection, the amount of capital should be determined in each project.

References