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THE EVALUATION CRITERIA OF THE VENTURE CAPITAL INVESTMENT ACTIVITY : AN INTERACTIVE ASSESSMENT (*)

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LES CRITERES D'EVALUATION DES INVESTISSEMENTS EN CAPITAL-RISQUE: UNE APPROCHE INTERACTIVE

RESUME

Ce cahier entreprend la modélisation de la décision en matière d'investissement en capital-risque, grâce au système interactif d'aide à la décision MINORA qui est fondé sur l'utilisation itérative du modèle de régression ordinale UTA. Dans un premier temps, le cahier présente un tour d'horizon des critères d'évaluation des investissements en capital-risque et la méthodologie générale du financement d'entreprises. Ensuite, il développe une application réelle du système MINORA dans un organisme financier français concernant la construction d'un modèle analytique d'évaluation des entreprises.
(Finance; Analyse Multicritère; Régression Ordinale)

THE EVALUATION CRITERIA OF THE VENTURE CAPITAL INVESTMENT ACTIVITY: AN INTERACTIVE ASSESSMENT

ABSTRACT

In this paper the modelling of venture capital decision making is being attempted, using a multicriteria decision support system (the MINORA system) based on the iterative use of the UTA ordinal regression model. First, a review of the literature on the evaluation criteria for venture capital investment is outlined and, the general methodology of financing enterprises is presented. Then, a real world application of the MINORA system is developed; this has been done in a French venture capital firm and concerned the assessment of an analytical evaluation model of enterprises.

(Finance; Multiple Criteria; Ordinal Regression)

1 - INTRODUCTION

The venture capital investment activity originated in the United States. It has recently become a means of financing new enterprises, in particular those developing new technologies and conquering new markets. Concurrently, however, it contributes to the development of the business spirit.

The assessment of venture capital investment in enterprises is a complex problem presupposing the existence of the proper, for its solution, methodology. The classical financial market theory produces theorems and rules concerning companies already introduced into the financial market.

Poindexter [11] has shown that venture capital investments differ fundamentally from the typical stock market investments, for the following reasons: (1) venture capital is invested in relatively new enterprises for which there are no sufficient historical data; (2) investment is enacted in small enterprises with direct capital contribution so that the investor actively participates in the enterprise life, which does not occur in large companies already introduced into the financial market; (3) venture capital investments do not ensure a short-term liquidity to the investor since the capital is "trapped" in the company for a period of five to ten years. Similar conclusions are drawn by Nouvellet [10], the director of the French venture capital firm SIPAREX to whom we shall refer later on in this paper.

The up-to-date literature on venture capital decision making (cf. section 2) is in no position to offer a methodological framework, capable of supporting the decisions of venture capital firms. The evaluation criteria differ from stu-

dy to study. Reliable operational tools for the modelling of those criteria through overall evaluation models have not been constructed yet.

This paper aims at providing such a tool to help decision-makers to assess, upon their own criteria, interactively and iteratively their own evaluation model. The decision support system MINORA, based on the iterative use of an ordinal regression model and on man-machine dialogue, is used for this purpose. Section 2 is a review of the literature on evaluation criteria of venture capital investments. A general framework for the investment activity within enterprises is given in section 3. The MINORA system is briefly presented in section 4. Sections 5 and 6 present a real world application to the French venture capital firm SIPAREX and, finally, in conclusion a comparative analysis between this study and previous results is given.

2 - PREVIOUS RESEARCH

The most crucial problems for the assessment of venture capital investments, relating to the evaluation of companies, are: the determination of evaluation criteria and their proper integration in an overall evaluation model which would allow for the rational and automatic selection of viable enterprises.

There are two distinct categories of empirical studies on such problems. The studies of the first category (cf. [17], [11], [16], [3], ...) aim at recording and rank-ordering all the criteria used by venture capital firms for the evaluation of enterprises. They are based on gallops and interviews held with small or large samples of such firms.

Wells [17] has personally interviewed eight firms and calculated the average weight of an adequate number of criteria. According to these findings he has produced the following rank order: management commitment (10.0); product (8.8); market (8.3), marketing skill (8.2); engineering skill (7.4); marketing plan (7.2); financial skill (6.4); manufacturing skill (6.2); references (5.9); other participants in deal (5.0); industry/technology (4.2); and cash-out method (2.3).

Poindexter [11] has adjusted a rank order of importance on such criteria from answers to questionnaires which he sent to a sample of 97 venture capital firms. The ranking, beginning from the strongest to the weakest criterion was: quality of management; expected rate of return; expected risk; percentage equity share of venture; management stake in firms; financial provisions for investor rights; venture development stage; restrictive covenants; interest or dividend rate; present capitalization; investor control; and tax shelter consideration.

Tyebjee and Bruno [16] have recently carried out a telephone survey on a sample of 46 venture capitalists through which they have calculated, for each criterion, the percentage of respondents mentioning it. Their conclusions appear in the following ranking (the importance index appears in parenthesis): management skills and history (89%); market size/growth (50%); rate of return (46%); market niche/position (20%); financial history (11%); venture location (11%); growth potential (11%); barriers to entry (11%); size of investment (9%); market/industry expertise (7%); venture stage (4%); and stake of entrepreneur (4%).

The studies of the second category (cf. [5], [9], [15], [16], ...) aim at modelling criteria through regression analyses, mostly linear ones. Hoban [5] used a model of multiple regression step by step, but he came to the conclusion that the 24 independent variables he used (outsider control of the board of director; venture capitalist on the board of director; age of the firm; management-founder team exists; management group has: management experience; production experience; finance experience; marketing experience; research and development experience; chief executive a generalist or specialist; level of education of the founder; number of previous employers of the founder; degree the product is technical; similar product on the market; stage of development of the product; multi or single product firm; extensiveness of the market evaluation; degree of competition; percentage of stock owned by the founders; percentage of stock potentially owned by the venture capitalist; size of the initial outlay by the venture capitalist; number of previous rounds of financing; product developed for a marked need; and percentage of production sold under contract) could not explain the variable: rate of return to the venture capitalist. The author attributes this to the fact that the evaluation criteria are too complex and/or subjective to be modeled quantitatively.

Lebas [9] attempted to analyse with multiple linear regression the correlation between one indicator of success of the company (cash flow/sales) and the three variables: innovation degree; financing degree and management degree. The study resulted in a much too small degree of correlation; the value of the correlation coefficient was only 0.46.

Tyebjee and Bruno [16] constructed five groups of criteria with the help of a factor analysis. The criteria were: market attractiveness; product differentiation; managerial capabilities; environmental threat resistance and cash-out potential. Following, the authors showed, by using regression analysis, the close dependence of the indicator "expected return" on the criteria "market" and "product", as well as the dependence of "risk" on "management" and "environment". Finally a bicriteria discriminant function was used based on return and risk: $z = 0.52x_{\text{return}} - 0.87x_{\text{risk}}$. This function was tested on a sufficient number of contracts from which it classified correctly: 68.4% of the rejected ones and 95.2% of the accepted ones. However it should be thoroughly investigated to what degree this bicriteria review of the problem is realistic and wholly acceptable to the world of venture capital firms.

The summarized analysis of the above mentioned empirical studies leads to two general conclusions: (1) the up-to-date developed evaluation models are incapable of interpreting previous decisions of venture capital firms and, consequently, are not to be used; (2) the necessity for the development of a decision-aid framework is confirmed.

The methodology suggested in section 4 aims at structuring preferences in ill-structured decision problems, simultaneously allowing decision makers to amplify their own rea-

soning. Siskos and Zopounidis [15] have applied this methodology in the IDI (Institut de Développement Industriel), a French venture capital firm, in the same way as for SIPAREX firm (see sections 5-6). The authors have assessed iteratively and interactively an additive utility function on twelve criteria, that is a weighted sum of estimated marginal utilities. Considering as a criteria ranking indicator the percentage weight of the marginal utilities, the achieved ranking order was: quality of management (23.2%); supplier credit (19.7%); net income (10.5%); accessibility to financial market (9.7%); diversification stage (9.4%); added value/turnover (7.2%); market niche/position (7.1%); world market share (6.2%); market trend (4.7%); R&D level (0.9%); turnover/inflation (0.8%); and productivity of work/cost of work (0.6%). The model of additive utility assessed by this process operates in IDI company as an operational tool to rationalize future decisions for the financing of enterprises.

3 - A GENERAL METHODOLOGY FOR THE FINANCING OF AN ENTERPRISE

The process of venture capital investment is generally sequential (cf. [16], [17]). Figure 1 presents this process in five stages, analyzed as follows:

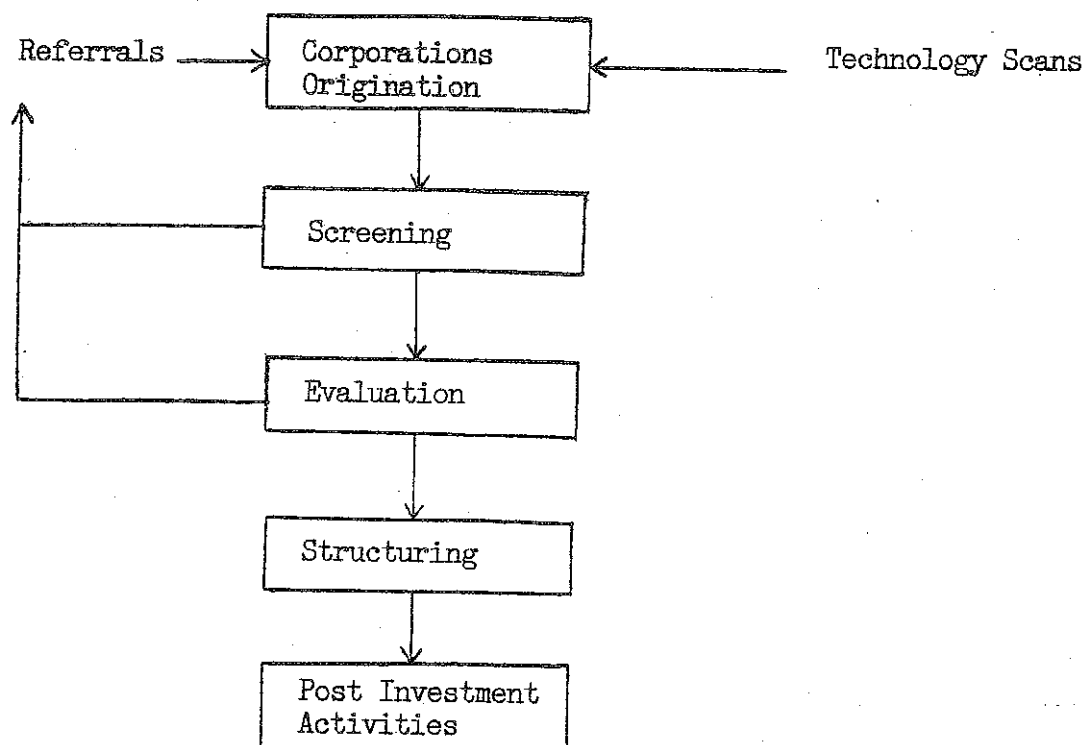


Figure 1: Decision process model of venture capital investment activity (source: [16]).

Corporations origination: Venture capital firms contact enterprises either on their own initiative or through other organizations, i.e. banks, credit firms, consultant companies, business men, ...

Screening: In this stage a first diagnosis of the enterprise's problems is made (new investments, capital control, ...). There follows an inquiry into the production sector and the general activity of the enterprise, its size and competitive position in the market.

Evaluation: This stage, probably the most significant, involves two partial analyses: the first one concerns work force organization and structure within the enterprise (internal analysis); the second one concerns the detailed financial analysis of the enterprise. In the case of SIPAREX (cf. section 5), for instance, this stage is the basis for the whole decision-making process, and requires the appropriate modelling. To be exact, the financial director of SIPAREX [10] believes that a modelling of this decision should seriously take into account qualitative rather than quantitative criteria, which reflect years of experience and skill in the business. At this point, one should point out the aversion of the up-to-date developed methods to information of qualitative nature. Finally, this stage should result in the construction of an analytical model which automatically evaluates each enterprise requiring the intervention of SIPAREX.

Structuring: This stage includes the negotiations between the venture capital firm and the enterprise for the determination of the height of the investment and the structuring of the financial and institutional framework.

Post investment activities: The activities of the participant firms are carried on even after the investment: they provide advice on matters of strategy of the managers of the enterprises being financed (market prediction, conquering of new markets, ...) and, generally, try to protect the invested capital. At this point, the usefulness of a decision-support model should be emphasized since this model could, at any moment, evaluate all the enterprises at stake and fully inform the participant firm.

The duration of the above mentioned sequential process is usually short. In reference to France, in the case of the "Institut de Développement Industriel" (cf. [15]) it lasts from one to two months, while in the case of SIPAREX from three

to six months. The "Institut de Développement Industriel" studies 10 to 15 enterprises per year and has already invested in 239 enterprises since its establishment, while SIPAREX studies 30 to 35 enterprises per year and has invested in 38 enterprises up to the present.

4 - A SKETCH OF THE MINORA DECISION SUPPORT SYSTEM

The methodology developed in this section is based on the decision support systems theory (cf. [2], [8]). This modern philosophy mainly refers to ill-structured decision problems and suggests methods operating iteratively and interactively through trial-error processes. The aim to be achieved is the decision maker's preference learning and, indirectly, the most effective decision-making.

The MINORA system (Multicriteria INteractive Ordinal Regression Analysis) seeks the assessment of analytical multicriteria decision models which are (or become) perfectly consistent with the externalized judgement policy of a decision maker through iterative ordinal regression analysis. The MINORA system is presented in [13], where there is also an application on sales strategy problems. Here, only a short description of the MINORA ideas will be given.

Other decision support systems, also based on regression analyses include: the POLICY system of Hammond et al [4] with special emphasis on resolution of international conflict problems, and the PREFCALC system for problems of buying decisions (see [7]). Overviews on multicriteria modelling and methods have been carried out by Roy and Vincke [12], Zeleny [18] and others.

In the MINORA system, the decision-maker externalizes his judgement policy by rank-ordering a certain number of "actions" coming from known decision-making situations, such as past choices, local or revealed preferences, The system optimally estimates the multicriteria additive utility function(s) which is (are) as consistent as possible with the decision maker's ranking. For this purpose, the ordinal regression me-

thod UTA [6] is used, especially in its improved version (see [14]). This method is based on special linear programming techniques.

The additive utility model, to be estimated, is analytically given by the following formulae:

$$u(\underline{g}) = \sum_{i=1}^n p_i u_i(g_i) \quad (1)$$

$$u_i(g_{i*}) = 0 \quad \forall_i \quad (2)$$

$$u_i(g_i^*) = 1 \quad \forall_i \quad (3)$$

$$\sum_{i=1}^n p_i = 1 \quad (4)$$

where, $\underline{g} = (g_1, g_2, \dots, g_n)$ the vector of performances of an action on n criteria; g_{i*} and g_i^* respectively the least and most desirable level of criterion g_i ; $u_i(g_i)$ the marginal utility function on criterion g_i ; p_i the relative weight of utility $u_i(g_i)$ and $u(\underline{g})$ the global utility of $\underline{g}$.

The above additive model is more general than the linear model used in common regression analyses. Moreover, it allows the use of qualitative criteria that is criteria evaluating actions on qualitative scales.

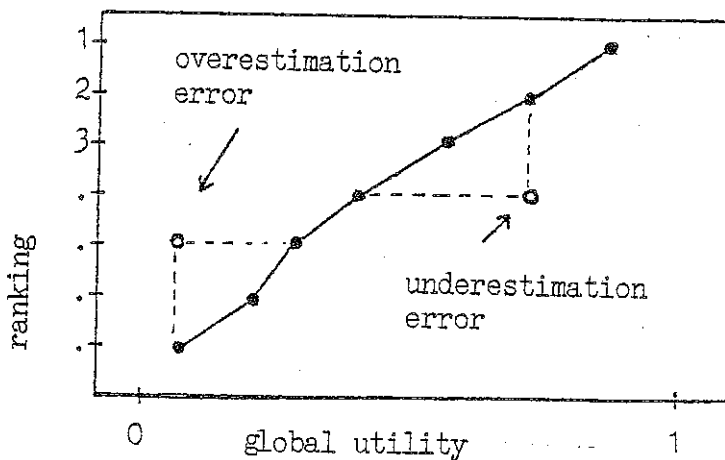


Figure 2: Ordinal regression curve (ranking versus global utility)

The MINORA system is a computerized trial-error process seeking to analyse and improve the consistency between the judgement policy of a decision-maker and the additive utility model (cf. figure 2). Full consistency is achieved when the maximum utility corresponds to the top of the ranking and falls progressively towards its tail. The cases of actions with high rank and low utility or actions with low rank and high utility are, respectively, considered as overestimation or underestimation errors by the decision-maker (fig. 2).

The MINORA "sets up" a dialogue between the man and the model of man, via the pictorial information of figure 2, aiming at the analysis of inconsistencies. In the course of this dialogue, the decision maker could accept to underevaluate or overevaluate actions according to the MINORA suggestions, whereat he modifies his judgement policy, or, he could even correct the model itself altering either the criteria modelling or the marginal utilities (trade-off analysis). The system, thus, returns to a new use of the UTA ordinal regression method (see [13] for details); it works on IBM compatible microcomputer systems.

Finally, the system uses two consistency measures: (1) indicator F , the sum of the positive and negative horizontal deviations round the regression curve; (2) Kendall's τ , measuring, from -1 to +1, the goodness of fit in terms of distance between the decision maker's ranking and that resulting from the global utility.

In the following two sections we shall present a real-world application of the MINORA system in a French venture capital firm.

5 - THE SIPAREX CASE STUDY

In Europe and particularly in France, venture capital appeared in two different types of organizations (cf. [1]): (1) institutions for the financing of new technologies, whose task is to finance the first stages of development in small and middle-sized enterprises; (2) institutions established to boost the resources of enterprises in full development, but, in their majority, not yet introduced into the financial market.

SIPAREX belongs to the second category and finances enterprises in the South-East of France. It was established in 1977 and is an Ltd. company, where none of the stockholders owns more than 10% of the shares. The firm has invested about 200 million French Francs in several enterprises up to the present.

The intervention axis of SIPAREX concerns the following five types of enterprise development: (1) development support; (2) technology development; (3) international development; (4) capital perennality and (5) introduction to financial market. Although the evaluation criteria, on which the firm's decisions are based, are, more or less well-known (cf. table 1), there is still no analytical model allowing an automatic diagnosis for each candidate enterprise. The nine qualitative criteria of table 1 were considered, by the financial manager of SIPAREX, as the real criteria for the selection of enterprises to be financed.

This criteria modelling using qualitative scales was adopted for two reasons: the criteria are complex and vague, making, therefore, impossible the formulation of quantitative indicators which would exhaustively measure the performance of the enterprise; for example, the criterion "information security" is the amalgamation of the following components:

Table 1: SIPAREX evaluation criteria

N°	Criteria definition	Scale	Code
1	Information security	maximum	3
		good	2
		passable	1
2	Market trend	in development	3
		constant	2
		in recession	1
3	Market niche/position	in progress	3
		constant	2
		in recession	1
4	Conjuncture sensibility	low	3
		medium	2
		high	1
5	Result trend	in progress	3
		constant	2
		in recession	1
6	Expected dividend rate	high	3
		medium	2
		low	1
7	Quality of management	excellent	3
		good	2
		passable	1
8	R & D level	very high	4
		high	3
		low	2
		non-existent	1
9	Accessibility to financial market	high	3
		medium	2
		low	1

accounting information security; strategy information (activity information about a long-term conquest of the market); and the company's competency to inform others; (2) the implicit method used by the financial manager himself in his own profession was taken into consideration.

For the application of the MINORA system, the decision-maker (the financial manager) should externalize his own judgement policy by ranking a sample of enterprises already financed and since kept under surveillance by SIPAREX. Twenty five companies were selected for this purpose, representing, by the end of 1983, 66% of the SIPAREX industrial participation portfolio.

In the first stage of MINORA, the decision maker classified the enterprises into 9 equivalent classes (each enterprise's rank and multicriteria evaluations, according to the code in table 1, are given in appendix). The enterprises in class 1 are characterized by their good competition market position, their progressive result trend and excellent management quality; most of them have already been introduced into the financial market (enterprises 2, 3, 4). In classes 2-3 there are dynamic companies soon to be promoted. In classes 4-6 we find average companies with a precarious position. Finally, problem companies are located in classes 7-9; three of those companies have already gone bankrupt (class 9).

In the following section, we present the process of structuring the financial manager's analytical evaluation model.

6 - THE INTERACTIVE ASSESSMENT OF THE EVALUATION MODEL

The application of the MINORA system in the case of SIPAREX was carried out in two stages, that is the same number as the ordinal regression analyses performed with the UTA method. The results of each stage are being analysed separately.

First ordinal regression analysis

The UTA method was used on the data in appendix. The estimated additive utility model was as follows:

$$\begin{aligned} u(\underline{g}) = & 0.044 u_1(g_1) + 0.164 u_3(g_3) + 0.009 u_4(g_4) \\ & + 0.347 u_5(g_5) + 0.031 u_6(g_6) + 0.031 u_7(g_7) \\ & + 0.373 u_9(g_9) \end{aligned}$$

Besides the criteria with zero weight ($p_2 = 0$, $p_8 = 0$), the marginal utilities $u_i(g_i)$ of the other criteria obtain only three values, namely the same number as that of the scale levels of each criterion. However, because of the normalization relations (2) - (3) we have, for each criterion, $u_i(1) = 0$ and $u_i(3) = 1$; then, the remaining values are assessed as follows:

$$\begin{aligned} u_1(2) = 0.613, u_3(2) = 0.622, u_4(2) = 1.0, u_5(2) = 0.308, \\ u_6(2) = 0.290, u_7(2) = 1.0 \text{ and } u_9(2) = 0.785. \end{aligned}$$

The consistency indicators between the financial manager's weak order and the model $u(\underline{g})$ obtained the values: Sum of horizontal deviations $F = 0.24$; Kendall's $\tau = 0.89$. The pictorial man-model consistency is given in figure 3. For each class, there are to be noted the utilities of companies correctly estimated as well as the company numbers which were either underestimated or overestimated by the decision maker.

The overestimated companies (note in parenthesis their global utilities) are: 2 (0.991); 4 (0.978); 5 (0.938); 16 (0.218) and 20 (0.102), while, the underestimated ones are: 8 (0.978); 11 (0.978); 17 (0.267), 18 (0.209) and 21 (0.111).

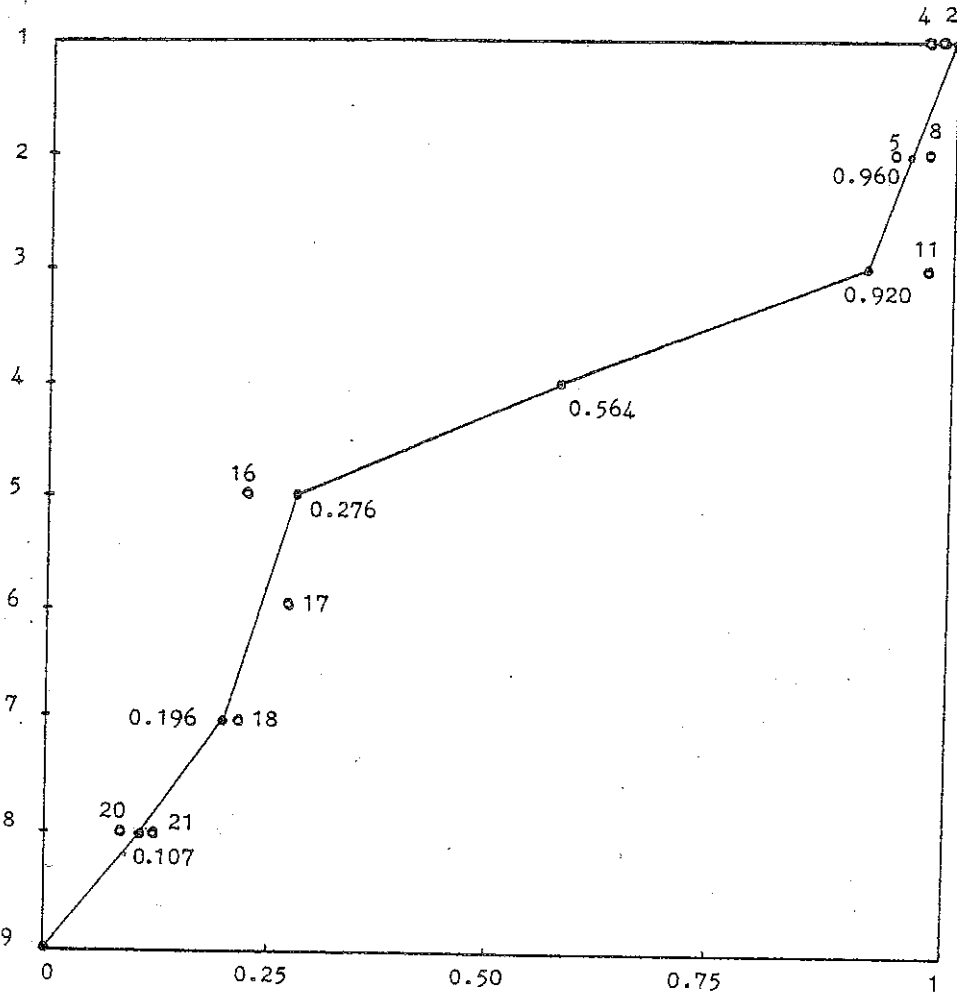


Figure 3: Ranking versus global utility (first analysis)

For the analysis of these inconsistencies, the MINORA system submitted through a micro-computer a series of questions about each ill-ranked company.

The man-machine dialogue developed as follows:

Company 2: The decision maker does not accept to demote the company according to the model's suggestion. The company is a world leader in skiing equipment. Its small global utility is mainly due to its evaluation on criterion 4, "conjuncture sensibility" (grade 1,

because its activity is seasonal). To reduce the impact on this criterion, the company manager has recently taken over a U.S.A. company manufacturing golf equipment. Thus, the decision maker alters the evaluation of the company on this criterion from grade 1 to grade 2.

Company 8: The decision maker insists on keeping this company in the same class with companies 6,7 and 9, but he modifies its evaluation on criterion 2, "market trend" from 3 to 1; this is due to the fact that the company takes on contracts from a large industrial group which has recently met with difficulties.

Company 16: The decision maker agrees to demote the company but he places it in the same class with company 17 (cf. fig. 3). However, he simultaneously alters its evaluation on criterion 7, "quality of management", from 1 to 2. The taking-over of company 16 by company 4 as well as its modernization have both contributed to this modification.

Company 11: The company is not promoted as suggested by the model. On the contrary, the decision maker alters its evaluation on criterion 2, "market trend", from 2 to 1. He does so, because the company has difficulty in controlling its markets and signs contracts with third world countries presenting great financial and political risks.

Company 18: According to the model's suggestion, this company is placed one class higher than 19. The decision maker changes its value from 1 to 2 on criterion 7, "quality of management", because the company has taken over by an industrial group (beginning of 1983), whose general manager is well-known in France for his competency in management techniques.

Companies 17 and 21: These are promoted according to the model's suggestions (cf. fig. 3), for the following reasons: The for-

mer already exports 70% of its output; moreover it is expecting an improvement in its productivity through a programme of new investments and the expansions of new commercial units in North America (same class as company 16). The latter is in a high technology production field.

Companies 4,5 and 20: These companies are demoted accordingly to the model's suggestion. Company 4 is dominated (*) by companies 1 and 3 of the same class; company 5 is demoted mainly owing to its market position (the largest part of its sales comes from production fields where the company plays a secondary role); finally, company 20 belongs to a traditional production field.

In consequence of the above modifications, the following new ranking appears (in parenthesis the company's class):

1 (1), 2 (1), 3 (1), 4 (2), 9 (3), 6 (3), 7 (3), 8 (3), 11 (3), 5 (4), 10 (5), 12 (6), 13 (6), 14 (7), 15 (7), 16 (8), 17 (8), 18 (9), 19 (10), 21 (11), 22 (12), 20 (13), 23 (14), 24 (14), 25 (14).

Second ordinal regression analysis

Following the modifications of the first stage within the appendix data base, the UTA method was re-used. Thus, a new additive utility function was assessed; its analytical formula is given below:

$$\begin{aligned} u(\underline{g}) = & 0.095 u_1(g_1) + 0.005 u_2(g_2) + 0.162 u_3(g_3) \\ & + 0.085 u_4(g_4) + 0.167 u_5(g_5) + 0.107 u_6(g_6) \\ & + 0.247 u_7(g_7) + 0.132 u_9(g_9) \end{aligned}$$

The marginal utilities $u_i(g_i)$ are completely defined by their

(*) $\underline{g}$ dominates $\underline{g}'$ if and only if $g_i \geq g'_i$ for every criterion i and for at least one criterion the inequality is strict.

intermediate values (extreme values being 0 and 1):

$$u_1(2) = 0.947, u_2(2) = 1.0, u_3(2) = 0.524, u_4(2) = 1.0, \\ u_5(2) = 0.754, u_6(2) = 0.794, u_7(2) = 0.983, u_9(2) = 0.242;$$

the weight of criterion 8 is zero ($p_8 = 0$).

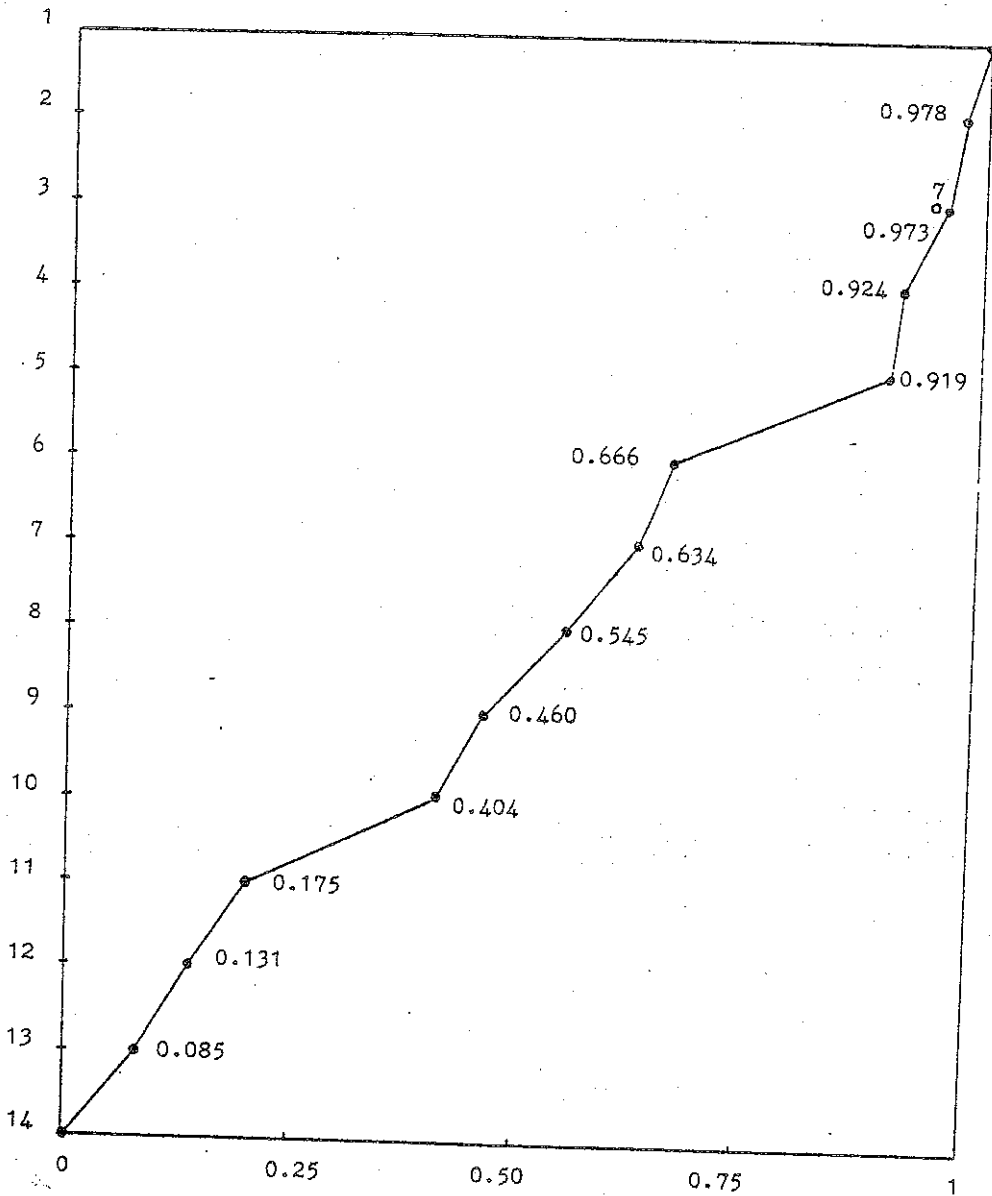


Figure 4: Company ranking versus global utility (second analysis)

The new model is almost totally consistent with the financial manager's judgement policy. As it is clearly shown in figure 4, there is only one deviation, that of company 7, its utility being 0.968. Therefore, the deviation sum from the regression curve is limited to 0.005, namely, what is required so that company 7 can be restored in its class (Kendall's $\tau = 0.99$).

In this case, the decision maker accepts the model's suggestion to demote company 7; the other companies in the same class (9, 6, 8 and 11) are better than 7 on the criteria "information security" and "market trend". Therefore, the application of the MINORA system is here terminated.

The above additive utility model was preserved for the evaluation of the remaining companies in the SIPAREX portfolio. There followed implementation of MINORA system on an IBM compatible microcomputer system for further use.

7 - SUMMARY AND CONCLUSION

In this paper, we have attempted a multicriteria analysis of venture capital investment activity. It appears that the preference modelling of venture capital firms can be neither static nor independent of each specific case.

In the structuring of the evaluation model, a major role is played by the decision support system approach, where the decision-maker learns his preferences through a trial-error process and, gradually, structures his own model, based on his own criteria. In the case of the French firm SIPAREX, presented here within, the MINORA system was used, based on the iterative use of an ordinal regression model.

Both in the empirical studies presented in section 2 and in the SIPAREX case, the criterion "management quality" appears to be the most essential components of the decision of venture capital investment. On the contrary, the criterion "R & D level" shows a zero weight; the study done in the firm I.D.I. [15] comes to similar conclusions. This is perhaps due to the fact that the Research and Development results are long-term profitable and uncertain (cf. [19]). Many companies having a high level of technology have not been able to profit from it; for instance, company 25 of the SIPAREX sample went bankrupt.

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