Investment Potential in Innovative Enterprises by A Venture Capital Fund from Brazil

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Abstract: The study aims at analyze the investment potential in emerging innovative companies by a Venture Capital fund from Brazil. The data was the grades obtained by 1,064 companies throughout the five geographic regions from Brazil, contained in the database of the fund and distributed in eightregional offices and analyzed by the investment fund in the period of 2007-2009. The seven items of the instrument used by the fund was analyzed by the item response theory and the results show that only five of them can measure the latent trait which in this study is the potential of investment of the applicant company. The Graded Response Model was used for calibration of the items and the construction of the scale of investment potential. Factor analysis of complete information confirmed the unidimensionality of the test. The items were analyzed and arranged in a scale with six levels. With this scale, the investment fund can decide whether or not a proposal should be deepened and improve the level of efficiency of the results of the evaluators.

Key words: Venture capital, item response theory, venture capital fund, investment potential, scale

INTRODUCTION

Venture capital is a kind of investment that funds high-risk projects but with high return by purchasing shares of privately held companies (Gompers and Lerner, 2001) and has significant impacts on the promotion of innovation and consequently on the economic development of a country (Chang et al., 2011).These investments, regarded as high risk by different factors, such as for example, illiquidity of assets, remunerate investors with potentially high returns and bridge the gap of the need of entrepreneurs for resources to fund innovative ventures. Returns are related to the ability of fund managers to identify opportunities for high-growth small and medium enterprises that are currently emerging or already on the market but lacking capital and organization to achieve further development (Rosa and Raade, 2006). Venture capital investments, according to Gupta and Sapienza (1992), begin in the form of seed capital or in subsequent rounds of re-investment and end with the departure of the fund from the company, usually when the company opens its capital or is sold to strategic investors. These investments, however are concretized after a series of stages from opportunity prospection to the completion of the investment and monitoring of the invested company (Hall and Hofer, 1993).

Since, human capital of venture capital funds are fixed resources which cannot be easily expanded (Fulghieri and Sevilir, 2009), the large number of proposals received becomes a significant bottleneck in the operation (Macmillan et al., 1985). The investor's decision to move beyond the initial reading of the business plan (screening) sent by the entrepreneur thus depends on the quality of information contained in this business plan (Mason and Stark, 2004). The study aims at analyzing the investment potential in emerging innovative companies by a venture capital fund from Brazil, understanding the mechanisms that affect the dynamics of the business is essential in the design of investment strategies, especially in the context of the global crisis started in 2008 (Oliveira and Tadeu, 2012; Prelipcean and Boscoianu, 2012). Thereto, the grades assignedto the information submitted by the companies by the fund evaluators were analyzed by means of Item Response Theory (IRT) to estimate how much the companies were ready to move forward in the fund's selection process and receive the investment.

Grades of 1,064 companies throughout Brazil, contained in the database of the fund and distributed in 8 regional offices were analyzed. The IRT (Item Response Theory) was used in this study as an unusual proposal in organizational studies when compared to classical statistical analysis which is more traditional. Therefore, it is necessary to develop new methods of entrepreneurship research and practioners, police makers and scholars must identify new methods to analyze and assist entrepreneurs to create new ventures, mainly in emerging economies

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(Ahmad *et al.*, 2010). Cai *et al.* (2012) stated that the start-up and development phases of an organization are not linear and require new methods of research. Moreira Jr. (2010) has pointed to the low number of qualified journals in organizational studies with the use of the IRT. Micheli and Manzoni (2010) state that performance measurement systems can differ in nature but can also be developed for different purposes. It is known that the way data is acquired, analyzed, interpreted and communicated impacts the performance of the organization (Bourne *et al.*, 2005) and for this reason the IRT is presented as an alternative but methodologically consistent, proposal for the suggested evaluation method and prominent research and evaluation in the organizational area. Samejima's Graded Response Model (Samejima, 1997) was used for calibration of the items and the construction of the scale of investment potential.

Venture Capital funds in their great majority, act as intermediaries between investors and companies that need resources. Its existence is justified for at least three reasons: efficiency approaching investors and entrepreneurs, capacity of assessment of good business and improvement of the risk-return ratio of investee companies through monitoring (Gupta and Sapienza, 1992). According to Tyebjee and Bruno (1984) the process of Venture Capital investment consists of five steps: the exploration of investment opportunities, screening in which most of the proposals are rejected based on the fund's investment criteria; evaluation where opportunities are assessed in detail, structuration of the deal which consists of the specific negotiation between the entrepreneur and the investor; post-investment activities by which the Venture Capital fund contributes to the growth of the company.

Shane and Cable (2002) said that the asymmetry of information between entrepreneurs (who know much about the business) and investors (who know little about the business) hampers investments. This difficulty is increased by poor quality business plans that offer little information. Universities and research centers conduct educational activities on start-ups but actions are needed on the fundamental levels of education in order to form entrepreneurs who are apt to design and conduct business (Virginia and Carlos, 2011). A good business plan is important for investors because it contributes to mitigate part of the risks of the investment. The business plan is an important indicator of the potential success of a business (Chen *et al.*, 2009). According to Mason and Stark (2004), more than three quarters of investors require business plans before considering investing. Furthermore, the decision to continue negotiations with the companies from the reading of the business plan, depends on its quality.

MATERIALS AND METHODS

The first step of the methodological process was the characterization of the sample of companies studied, followed by the research procedures of IRT. As already mentioned, the sample consists of companies that have applied to receive investment from a Brazilian Venture Capital Fund. The database comprehends 1,064 companies around Brazil that were analyzed by the investment fund in the period of 2007-2009. This database contains the complete records of firms as well as the analysis conducted by regional managers of the fund. This step consisted of the initial part of the Fund's evaluation process, during which seven aspects were evaluated by using grades from 1-4. The opportunities which obtained the best grades advancedin the selection process and received a detailed examination by the Fund's team. The process described, therefore can be considered a census study that covers all regions of Brazil and prone to generalizations about the form of evaluation of a Venture Capital Fund. For purposes of confidentiality, the name of the investment fund as well as the characterization of the regional offices will be omitted.

The instrument was completed by analysts and fund managers based on the information provided by the applicant companies to receive investment. Although, there were some criteria for attributing the grades, they were assigned according to the assessment of the analyst himself. As each region had different analysts, the data may have suffered bias due to the profile of each evaluator. Three companies were not evaluated and therefore eliminated from the sample, resulting in 1,064 respondents.

This study uses assessments by investors and analyzes the results through, the Item Response Theory (IRT). The IRT is usually applied in education (Klein and Fontanive, 2009; Primi *et al.*, 2010; Kang and Chen, 2011) and studies about the physical and mental health (Hays *et al.*, 2007; Cella *et al.*, 2010; Van Nispen *et al.*, 2010; Baptista and Gomes, 2011; Egberink and Meijer, 2011; Massof, 2011;Sikkes *et al.*, 2011) for calibration and analysis of questionnaire items. The IRT has advantages over the Classical Test Theory (CTT) such as allowing the evaluation of different groups with a single scale (Tezza and Bornia, 2009). However, the use of IRT to assess organizations and organizational processes has been growing (Alexandre *et al.*, 2002; Balbim Jr. and Bornia, 2011; Vasconcelos *et al.*, 2013) but still in an embryonic and dispersed manner which grants actuality and relevance to this study. According to ToCai *et al.* (2012), the entrepreneurial activities are diverse and complex and require the development of research models to encompass this range of types and formats of business.

This study uses Samejima's Graded Response Model (Samejima, 1997; Andrade *et al.*, 2000) represented by Eq. 1 where $P^{+}_{i,k}(\theta_j)$ is the probability of an individual responding the item i for the category greater than or equal to k. Equation 1; Samejima Graded Response Model Samejima (1997)'s:

$$P^{+}_{i,k}(\theta_j) = \frac{1}{1+e^{-a_i(\theta_j - b_{i,k})}} \qquad (1)$$

The parameter a_i is the same in all categories of the scale of the item i and $b_{i,k}$ is the degree of difficulty of the kth category of item I, being the probability of an individual responding to a specific category the difference given by the equation through $P_{i,k}(\theta_j)$. Equation 2; probability of an individual j checking the option k in the item i (Samejima, 1997):

$$P_{i,k}(\theta_j) = P^{+}_{i,k}(\theta_j) - P^{+}_{i,k+1}(\theta_j) \qquad (2)$$

The research was conducted in four phases: data treatment, calibration of items, scale construction and testing of dimensionality. The instrument contains seven items filled on a 4-point Likert scale (Table 1).

The Software Multilog (Thissen *et al.*, 2003) was used for the calibration of items and for the estimation of the scores. A calibration of items is the estimation of the parameters a_i e $b_{i,k}$ to measure the latent trait which in this study is the potential of investment of the applicant company. The program generates the parameters that are evaluated to verify their convergence to satisfactory errors that serve to estimate the scores and construct a scale of company evaluation.

For the construction of the scale, it is needed to define the anchor items which must simultaneously satisfy the three conditions defined in the literature reference. It makes more sense to call them anchor categories instead of anchor items because it is a model of gradual response and not a dichotomous model (Andrade *et al.*, 2000; Valle, 2001):

$$P(U = 1 | \theta = Z) \geq 0.65$$
$$P(U = 1 | \theta = Y) < 0.50$$
$$P(U = 1 | \theta = Z|) - P(U = 1 | \theta = Y) \geq 0.30$$

Because, it is difficult to meet the conditions of the model so that a category is an anchor, the following situations were chosen as sufficient or nearly-anchors:

$$P(U = 1 | \theta = Z|) \geq 0.60 \text{ and } P(U = 1 | \theta = Y) < 0.50$$
$$P(U = 1 | \theta = Z|) \geq 0.65 \text{ and } P(U = 1 | \theta = Y) > 0.50$$

reliance upon appraisal. The model forecasts the intervention of a specialist to dispel doubts regarding the construction of the scales which in this study will be performed by one of the researchers with expertise in the evaluation of companies applying to receive investment by the venture capital fund. The definition of the anchor categories of the scale presupposes the perception of the behavior of the item to set the cutoff level between levels of the scale.

The factor analysis is conducted on the database to test the dimensionality of the instrument. It is used to determine whether the items measure a single latent trait

Table 1: Criteria for analysis of companies applying to receive the fund's investment

Analysis item	1	2	3	4
Team	Team without differential (technical, managerial or motivational) and/or having a difficult relation	Team with differentials but not entrepreneurial	Entrepreneurial team with differentials and an entrepreneur open to share the management	Entrepreneurial team with great differentials and excellent relationship
Technology	Technology without a solid scientific basis, it is easily copyable or very similar to competitors'	Science-based technology, it is easily copyable; incremental differential in relation to the competitors	Science-based technology, it is not easily copyable; incremental differential in relation to the competitors	Science-based technology, it is not easily copyable; offers great differential in relation to the competitors
Market	It is not clear which problem the technology solves and the market segment is diffuse or highly competitive	There are doubts on how to implement the technology but the market segment is growing and/or consistent	The technology solves a clear problem and the market segment is diffuse or highly competitive	The technology solves a clear problem and the market is growing and/or consistent
Financial	Low EBITDA (initial parameter is estimated below 15%)	EBITDA estimate up to 30% and revenues above R$5 million	EBITDA estimate greater than 30% and revenues exceeding R$ 15 million in 5 years	Strong indications of EBITDA above 30% and revenues exceeding $ 15 million in 5 years
Divestment	Difficult divestment, even if significantly profitable	Potential financial investors	Potential strategic investors	There is already interest in buying the business
Need for capital	Intensive capital (requiring more than R$10M)	Capital needs beyond the total available by the Fund (over R$5M)	Need for two rounds of investments within the Fund's limit (up to R$ 5M)	Necessary capital within the limit of the Fund's first round (R$ 1.5M)
Feasibility	D-discard	C-poor	B-monitoring	A-priority

or if there are other dimensions involved. For this evaluation, a factor analysis of complete information is proceeded to model the probability of an individual responding each combination of categories of items. It is considered that the instrument has k dimensions if the χ^2 based on the likelihood χ^2_k test with gl_k degrees of freedom, meets the requirements of $\chi^2_k/gl_k < 3$ and $p<0.05$ (Bock *et al.*, 1988).

RESULTS AND DISCUSSION

This study presents the main results obtained from the study of 1,064 applicants to the fund's investment.

Parametersofthe items: The results are presented in the same order they were generated in the scale with an average = 0 and SD = 1. The estimates of the item parameters are shown in Table 2, including the seven items of the instrument and the parameters "a" (index of discrimination) and the parameters of difficulty b_2, b_3, b_4. It was observed that all items calibrated with four levels, although certain considerations need to be made. The item "need for capital" obtaineda very low a parameter (0.57) and this, according to the specialist was due to the fact this item is independent of the latent trait because it only seeks to assess whether the need for capital of the project was within the range of the fund's investment. Thus, both companies with low or high potential investment that need resources beyond the investment capacity of the Fund for example would have a low score on this item. Therefore, the item was removed from the instrument and consequently will not compose the scale. Another object of analysis was "feasibility". The feasibility of the business or the potential to receive investment is precisely what the IRT measured. According to the specialist, the grade assigned is arbitrated by the evaluator and sets the routing to be given to the proposal not necessarily representing the

final score of the latent trait. For this reason, despite having the highest parameter among the items (2.65), there was no logic in keeping this item on the instrument, therefore, it was also removed. The parameters were once again estimated in the Multilog software (Thissen *et al.*, 2003) and the results for the first five items did not change in relation to what had already been presented in Table 2. It's important to observe the items with the highest parameter or that discriminate organizations with greater or lesser investment potential the most which in order of importance are "financial", "market", "technology", "staff" and "disinvestment" which shows that for the evaluation instrument of this investment fund, the possibility of high returns on capital invested in the new business is the most important item.

Regarding the parameter $sb_{i,k}$, the inverse phenomenon to the parameter a occurs. The item "disinvestment" is the most "difficult" to be graded with the value 4 and therefore will only be attributed to companies with high investment potential. One of the features of the IRT is that the method positions the respondent and the items on the same scale. To facilitate this understanding, the characteristic curve of the item"Market" is presented in Fig. 1. Keys of Fig. 1 and the parameters are shown in Table 3.

The parameters indicate that companies with latent trait (investment potential) ≥-0.83 in the scale (0.1) have a 50% chance that there are doubts concerning the form of technology application but the market segment is growing and/or consistent. By analyzing the same chart, it's also inferred that for companies with latent trait >0.32 there is a 50% chance that the technology solves a clear problem and that the market segment is highly competitive and diffuse and for companies with latent trait >1.51 there is a 50% chance that the technology solves a clear problem and that the market is growing and/or consistent.

The analysis of the parameters was developed for five items and Fig. 2 shows the total curve of information

Table 2: Estimates of the item parameters

Item	Description	a	b2	b3	b4
Team	Evaluates the experience, technical and managerial differentials of the entrepreneur and his team as well as the motivational aspects and relationship	1.47	-0.97	-0.03	1.52
Technology	Evaluates the scientific basis of the proposal, the ease of technology being copied, the degree of innovation proposed (incremental or radical) and the possibility of creating a technological platform (new products)	2.06	-0.52	0.86	2.14
Market	Assesses whether it is clearly defined what problem will be solved with its implementation as well as the potential and the market conditions of the proposed product/service	2.19	-0.83	0.32	1.51
Financial	Examines the potential for revenue growth and the possibility of achieving high EBITDA margins	2.47	-0.25	1.09	2.14
Divestment	Assesses the possibilities of divestment for the Fund through the interest of potential financial and strategic investors	1.40	-0.96	0.19	3.55
Need for Capital	Seeks to assess if the need for company resources (to reach break-even and generate a positive cashflow) is compatible with the Fund's investment capacity	0.57	-2.24	-0.36	1.07
Feasibility	Sorts opportunities received within the Fund's pipeline, providing guidance for the next steps (discard, monitoring, advancing negotiations for investment)	2.65	0.60	1.54	2.21

Table 3: Keys of Fig. 1

| Curve	Equation of the curve
Curve 1: probability of a company j be evaluated by first option (k = 1) for the question i about "market" according to its score	$P_{i,1}(\theta_j) = \dfrac{1}{1+e^{-2.19(\theta_j+0.83)}}$
Curve 2: probability of a company j be evaluated by second option (k = 2) for the question i about "market" according to its score	$P_{i,2}(\theta_j) = \dfrac{1}{1+e^{-2.19(\theta_j+0.32)}} - P_{i,1}(\theta_j) = \dfrac{1}{1+e^{-2.19(\theta_j+0.83)}}$
Curve 3: probability of a company j be evaluated by third option (k = 3) for the question i about "market" according to its score	$P_{i,3}(\theta_j) = \dfrac{1}{1+e^{-2.19(\theta_j+1.51)}} - P_{i,2}(\theta_j) = \dfrac{1}{1+e^{-2.19(\theta_j+0.32)}}$
Curve 4: probability of a company j be evaluated by fourth option (k = 4) for the question i about "market" according to its score	$1 - P_{i,3}(\theta_j) = \dfrac{1}{1+e^{-2.19(\theta_j+1.51)}}$
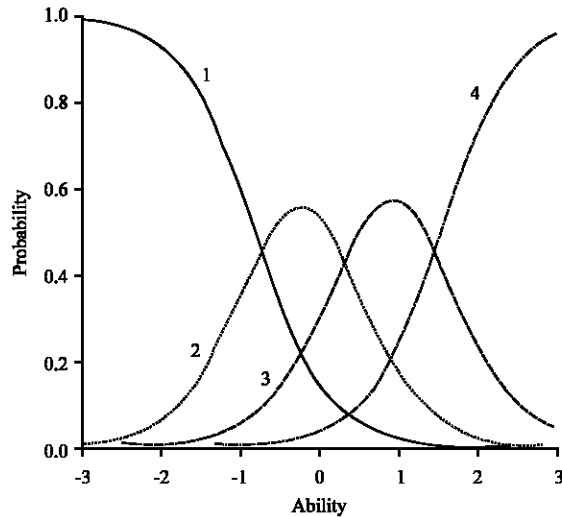
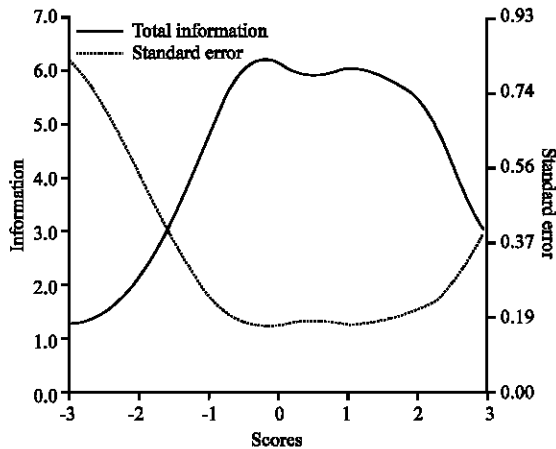Fig. 1: Characteristic curve and information curve of the item "market"

Fig. 2: Total information curve of the instrument

which gathers the total information of items (full line) and associated errors (dotted line). Through, the total curve of information, it can be verified that the instrument is suitable to measure the potential investment in a range between -1.6 and 3 in which information is larger than the error. The minimum possible value for the score is -1.552 when all the answers of the items are equal to 1 and the

maximum score is 2.630 when all answers are equal to 4. Thus, regardless of the set of responses to the five items, all companies will be in the range [-1.6, 3.0] in which the instrument is adequate to measure the latent trait.

The histogram in Fig. 3 shows the distribution of scores generated by the parameters of the items. It is observed that the average and standard deviation of the estimated scores (0.01, 0.85) are close to the expected average and standard deviation expected (0.1). There is a slight leftward asymmetry due to the high number of proposals that were not within the investment profile of the fund. Among these proposals it is possible to cite a few examples such as companies that sent only part of the information requested who filled the fields in a superficial manner or that were not technology-based companies. The observed asymmetry is consistent with the literature. Mason and Harrison (2002) argue that although, >90% of investors have an interest in making new investments, several barriers reduce the amounts invested in companies such as the inadequacy of the companies to the investment funds' criteria.

The scale: In order to improve the understanding of the results, linear transformation was used in the estimation of investment potential with the average and standard deviation (0,1) to respectively (300,50). This measure also prevents companies from receiving negative scores which could induce a negative signal as lack of potential for investment which would be a serious misinterpretation of data. The items were analyzed and arranged in a scale with six levels, defined by the anchor items which characterize the potential investment (Table 4).

Factor analysis and dimensionality test: Initially, it was conducted a factor analysis of the principal components which is an exploratory descriptive study of the behavior of the variables but not confirmatory of the test dimensionality. In the sequence, a test was performed to verify the unidimensionality of the components. Figure 1 generated in the R software using the psych package (polychoric function), highlights factor 1 with autovalue equal to 2.99 much higher than the autovalue of 0.65 for factor 2 which suggests the unidimensionality of the test, i.e., the items measure a single latent trait.

Table 4: Scale of investment potential of new companies

| Level of the scale	Interpretation of the scale
250	Team without differential (technical, managerial or motivational) and/or having a difficult relationship, technology without a solid scientific basis, it is easily copyable or very similar to competitors', it is not clear which problem the technology solves and the market segment is diffuse or highly competitive, the potential of EBITDA generation is low with initial parameter estimated below 15%), the business has a difficult divestment, even if it's significantly profitable.
300	Team with differentials but with low entrepreneurial potential, the technology is science-based but it is easily copyable with an incremental differential in relation to the competitors, there are doubts on how to implement the technology but the market segment is growing and/or consistent, revenue estimate above R$5 million and EBITDA up to 30%, concerning divestment, it generates interest in potential financial investors
350	Entrepreneurial team with differentials and an entrepreneur open to share the management, the technology is science-based but it is easily copyable with an incremental differential in relation to the competitors, the technology solves a clear problem and the market segment is diffuse or highly competitiv, revenue estimate exceeding R$5 million and EBITDA up to 30%, concerning divestment, it generates interest in potential strategic investors
400	Entrepreneurial team with great differentials and excellent relationship, the technology is science-based, it is not easily copyable and has incremental differential in relation to the competitors, the technology solves a clear problem and the market is growing and/or consistent, EBITDA estimate above 30% and revenue exceeding R$15 millionin 5 years, concerning divestment, it generates interest in potential strategic investors
450	Entrepreneurial team with great differentials and excellent relationship, the technology is science-based, it is not easily copyable and has radical differential in relation to the competitors; the technology solves a clear problem and the market is growing and/or consistent, EBITDA estimateabove 30% and revenue exceeding R$15 million in 5 years, concerning divestment, it generates interest in potential strategic investors
500	Entrepreneurial team with great differentials and excellent relationship, the technology is science-based, it is not easily copyable and has radical differential in relation to the competitors, the technology solves a clear problem and the market is growing and/or consistent. EBITDA estimate above 30% and revenue exceeding R$15 million in 5 years, concerning divestment,there has already been shown interest in buying the business
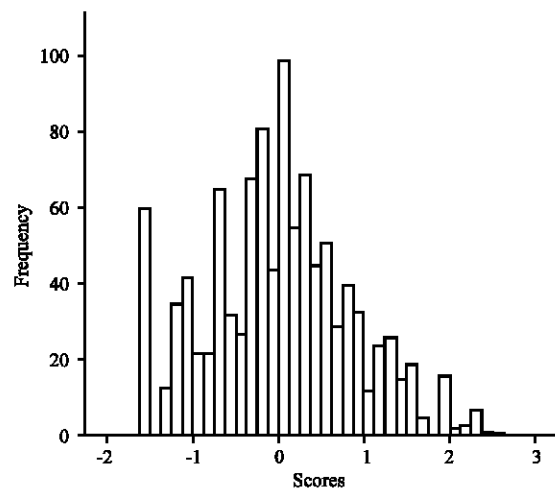
Fig. 3: Histogram of scores of the enterprises

Fig. 4: Factor analysis of the principal component

The factor analysis of complete information was applied to confirm the unidimensionality observed in factor analysis of the principal components. The results to a single factor point that the value of χ^2_k is of 21,14 with 10 degrees of libertyand p<0.00076 results that meet the conditions required by the model. It is concluded, thus that the instrument is actually unidimensional as desired (Fig. 4).

The study proved that IRT can be applied to organizational studies and specifically in the analysis of companies seeking funds from investors. A scale with six levels was prepared with information about the potential of each company, enabling the fund to assess and guide
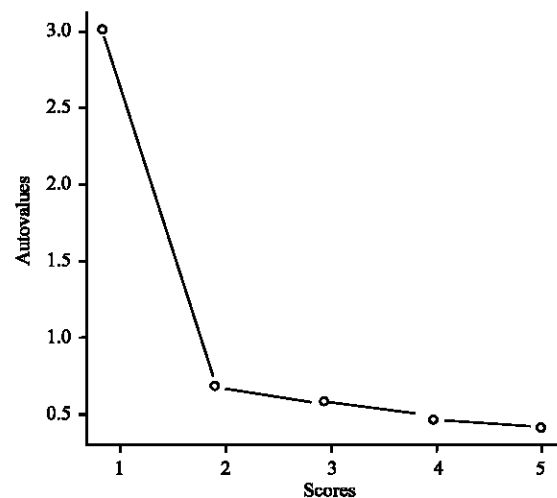
proponents regarding the strengths and weaknesses of their proposal. With this scale, the investment fund can decide whether or not a proposal should be deepened and improve the level of efficiency of the results of the evaluators.

The results show that the parameters of the item "need for capital" did not calibrate due to the fact that it does not measure the latent trait which culminated in the recommendation to delete the item from the instrument. The item "feasibility" was considered redundant by experts and also removed from the instrument.

The proposed instrument was adequate to assess the viability of any proposal submitted to the fund because

the amount of information generated by the test is enough to cover any possible score. It is recommended to create other items for the instrument which currently are five because they cover a limited number of requirements for assessing the viability of a business. Another suggestion would be to divide these items into more specific ones. For example, "market" could be divided into customers, competitors, business model, among others.

The evaluation model, through IRT allows new items to be included in the future and new analyzes to be carried out with appropriate changes in the scale without needing to eliminate the current results.

CONCLUSION

Finally, it is recommended to retrain evaluators to align the instrument information and to assist them in the interpretation of the scale.

REFERENCES

Ahmad, N.H., H.A. Halim and S.R.M. Zainal, 2010. Is entrepreneurial competency the silver bullet for sme success in a developing nation? Int. Bus. Manage., 4: 67-75.

Alexandre, J.W.C., D. Andrade, A.P. Vasconcelos and A.M.S. Araujo, 2002. A proposed analysis of a construct for measuring the critical factors of quality management through the item response theory. Gestao Producao, 9: 129-141.

Andrade, D.F., H.R. Tavares and R.C. Valle, 2000. Item Response Theory: Concepts and Applications. ABE, Sao Paulo.

Balbim Jr., A. and A.C. Bornia, 2011. Proposal for a measurement instrument to assess satisfaction of bank customers using item response theory. Gestao Prod., 18: 541-554.

Baptista, M.N. and J.O. Gomes, 2011. Baptist depression scale (Adult Version)-Ebadep-A: Evidence of construct validity and criterion. Psico-USF, 16: 151-161.

Bock, R.D., R. Gibbons and E. Muraki, 1988. Full-information item factor analysis. Applied Psychol. Measure., 12: 261-280.

Bourne, M., M. Kennerley and M. Franco-Santos, 2005. Managing through measures: A study of impact on performance. J. Manuf. Technol. Manage., 16: 373-395.

Cai, L., Q. Liu, S. Deng and I. Alon, 2012. A general review of entrepreneurship research (1998 to 2010): Theoretical implications, management applications and future research directions. Afr. J. Bus. Manage., 6: 474-492.

Cella, D., W. Riley, A. Stone, N. Rothrock and B. Reeve *et al.*, 2010. The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005-2008. J. Clin. Epidemiol., 63: 1179-1194.

Chang, C.Y., F. Wang, J. Chen and H.P. Fu, 2011. Analysis of the factors that influence Venture Capital fundraising: An empirical study in China. Afr. J. Bus. Manage., 5: 4765-4774.

Chen, X.P., X. Yao and S. Kotha, 2009. Entrepreneur passion and preparedness in business plan presentations: A persuasion analysis of Venture Capitalists' funding decisions. Acad. Manage. J., 52: 199-214.

Egberink, I.J. and R.R. Meijer, 2011. An item response theory analysis of harter's self-perception profile for children or why strong clinical scales should be distrusted. Assessment, 18: 201-212.

Fulghieri, P. and M. Sevilir, 2009. Size and focus of a venture capitalist's portfolio. Rev. Financial Stud., 22: 4643-4680.

Gompers, P. and J. Lerner, 2001. The venture capital revolution. J. Econ. Perspect., 15: 145-168.

Gupta, A.K. and H.J. Sapienza, 1992. Determinants of venture capital firms' preferences regarding the industry diversity and geographic scope of their investments. J. Bus. Venturing, 7: 347-362.

Hall, J. and C.W. Hofer, 1993. Venture Capitalists' decision criteria in new venture evaluation. J. Bus. Venturing, 8: 25-42.

Hays, R.D., H. Liu, K. Spritzer and D. Cella, 2007. Item response theory analyses of physical functioning items in the medical outcomes study. Med. Care, 45: 32-38.

Kang, T. and T.T. Chen, 2011. Performance of the generalized S-X2 item fit index for the graded response model. Asia Pacif. Educ. Rev., 12: 89-96.

Klein, R. and N. Fontanive, 2009. A new way to evaluate the writing skills in ENEM's compositions. Essay: Eval. Public Policy Educ., 17: 585-598.

Macmillan, I.C., R. Siegel and P.N.S. Narasimha, 1985. Criteria used by venture capitalists to evaluate new venture proposals. J. Bus. Venturing, 1: 119-128.

Mason, C. and M. Stark, 2004. What do investors look for in a business plan? A comparison of the investment criteria of bankers, venture capitalists and business angels. Int. Small Bus. J., 22: 227-248.

Mason, C.M. and R.T. Harrison, 2002. Barriers to investment in the informal venture capital sector. Entrepreneurship Reg. Dev., 14: 271-287.

Massof, R.W., 2011. Understanding rasch and item response theory models: Applications to the estimation and validation of interval latent trait measures from responses to rating scale questionnaires. Ophthalmic Epidemiol., 18: 1-19.

Micheli, P. and J.F. Manzoni, 2010. Strategic performance measurement: Benefits, limitations and paradoxes. Long Range Plann., 43: 465-476.

Moreira Jr., F.J., 2010. Applications of Item Response Theory (IRT) in Brazil. Rev. Bras. Biom., 28: 137-170.

Oliveira, C.A.A. and F.B. Tadeu, 2012. Determinants of private investment in Brazil: An empirical analysis of the period 1996-2011. Int. Bus. Manage., 6: 471-475.

Prelipcean, G. and M. Boscoianu, 2012. Optimal investment strategies for SMEs in critical and turbulent period. Afr. J. Bus. Manage., 6: 8910-8916.

Primi, R., L.F.D. Carvalho, F.K. Miguel and M.C.R.D. Silva, 2010. Differential item functioning of the national student exam for psychology (ENADE) 2006. Psico-USF, 15: 379-393.

Rosa, C.D.M. and K. Raade, 2006. Profitability of venture capital investment in Europe and the United States. European Comission, Brussels, 13 July 2011, pp: 1-24.

Samejima, F., 1997. Graded Response Model. In: Handbook of Modern Item Response Theory, Van Der Linden, W.J. and R.K. Hambleton (Eds.). Springer, New York, pp: 85-100.

Shane, S. and D. Cable, 2002. Network ties, reputation and the financing of new ventures. Manage. Sci., 48: 364-381.

Sikkes, S.A.M., D.L. Knol, M.T. van den Berg, E.S.M., de Lange-De Klerk and P. Scheltens *et al.*, 2011. An informant questionnaire for detecting Alzheimer's disease: Are some items better than others? J. Int. Neuropsychol. Soc., 17: 674-681.

Tezza, R. and A.C. Bornia, 2009. Item response theory: Advantages and opportunities for production engineering. Proceedings of the 29th National Meeting of Production Engineering, October 11-14, 2009, Salvador, BA.

Thissen, D., W. Chen and R. Bock, 2003. Multilog (version 7) [computer software]. Scientific Software International, Lincolnwood.

Tyebjee, T.T. and A.V. Bruno, 1984. A model of venture capitalist investment activity. Manage. Sci., 30: 1051-1066.

Valle, R.C., 2001. Construction and interpretation of scales of knowledge: A case study. Escudos Avaliacao Educ., 23: 71-92.

Van Nispen, R.M.A., D.L. Knol, H.J. Neve and G.H.M.B. van Rens, 2010. A multilevel item response theory model was investigated for longitudinal vision-related quality-of-life data. J. Clin. Epidemiol., 63: 321-330.

Vasconcelos, A.M.D., A.G.R. Lezana and D.F. Andrade, 2013. Scale for measuring the success of micro and small companies in Santa Catarina with the support of item response theory. Revista Brasileira Gestao Desenvolvimento Regional, 1: 91-119.

Virginia, B.S. and A.S. Carlos, 2011. Reasons to create a new venture: A determinant of entrepreneurial profiles. Afr. J. Bus. Manage., 5: 11497-11504.