Deriving successful venture capital deal profile through decision tree analysis in Indian context

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Abstract

Purpose – This study is based on the development of predictive classification for the success of a venture capital (VC) deal derived from both qualitative and quantitative indicators.

Design/methodology/approach – Decision tree analysis has used for devising the success model of VC deal. Various deal characteristics are considered in this study as the observable component of success.

Findings – The finding of this analysis indicates that the success of the deal does not only depend on the final outcome like post company valuation (POST_COMP), realised revenue (RREV) but also depends on various observable contractual characteristics like syndication, use of convertible security and ownership percentage with some noticeable deal features.

Practical implications – This study increases the further scope of study on a contractual mechanisms such as allocation of cash flow right and control right in the deal contract between venture investor and entrepreneur firm. This could give a better understanding of success path of a venture deal.

Originality/value – This study has attempted to derive a performance model based on observable attributes of a VC deal.

Keywords Success model, Decision tree analysis, Observable component

Paper type Research paper

Introduction

In the present era, venture capital (VC) emerged as one of the potential pillars in private equity industry. For funding, a budding start-up venture fund garners their mainstream interest. In recent years many VC backed start-up have witnessed higher return across the globe i.e Flipkart, Yes Bank, Facebook, Inc., Google, Xactly, Chegg, etc.

The great support of VC industry is that venture capitalist effectively increases output with a given input through innovation. They invest in start-up firm because innovation is brought to market by these young entrepreneurs. But innovation encounters a higher risk of investment return. This risk arises due to various problems like agency problem, information asymmetry and adverse selection problem. Venture investors are considered to be experts in handling problems. They structure the whole investment process that each and every mechanism found interlinked and provide scope for managing the adversity of any situation.

They start with proper screening criteria for selection of portfolio firm (Chan, 1983), then make use of financial contract (Kaplan and Stromberg, 2004) and constantly monitor the progress (Hellman, 1998a, b; Cornelli and Yosha, 2003) for the development of business and success of the deal. An active VC market can spur the economy as it can provide positive externalities in the economy. Therefore the success of a VC deal is auspicious for the growth of country's economy.

Information regarding VC industry and various deals are available in many electronic and print media. But all these information are not sufficient to understand the deal flow and

performance of a VC deal. Venture capitalists are generally maintaining secrecy in this regard. In India getting inputs on VC investment is very difficult. Very few studies have done for analysing the success of an Indian VC deal. The previous literature have evident that use of a financial contract with the various deal attribute is having a key role in the success of the deal. This study has attempted to explore those deal specific attributes and contractual feature which leads to accomplishment of goal of the venture capitalist and bring success to the deal in the Indian context.

Theoretical background

The success of a venture investment is characterised by high degree of uncertainty (Tyebjee and Bruno, 1984; Rhunka and Young, 1987). This is the most desired antecedent of all venture capitalist who made a long term investment decision on a risky and unproven business plan, where it lays equal probability of success and failure of their decision.

It is quite difficult to predict the outcome of the investment decision in terms of success failure in distant future. Several analysing models have been developed to predict the future result.

Venture capitalists are the shareholder of the portfolio firm, so their ultimate motive tends to minimise the risk and maximise the return at different point of time. In general, it is not possible to minimise the risk and maximise the return simultaneously as this is an imminent concept. So VC investor either tries to minimise the risk to realise a certain return level or maximise the return at an acceptable level of risk.

VC investment involves multiple steps of decision from a selection of security for investment to managing and exit decision from portfolio firm. They define success as the successful exit with the desired level of return realisation. Sometimes their success relates to the realisation of the original amount of investment from a highly risky and volatile business.

According to Tykova and Tereza (2000), the relationship between venture capitalist and entrepreneur firm is beyond a typical principal–agent framework. Venture capitalists effort is crucial for the success of the venture. Their participation in organisational strategy, financial and other business decision add value to the business venture. They have experience in managerial activities. Agency theory explains the involvement of a principal and an agent in any relationship incurs agency cost due to their conflict.

In a VC deal, venture capitalist and entrepreneur firm enter into a contract that influences their behaviour in during deal flow and business operation. The basic element of this contract includes (1) staging of the fund or round investment, (2) use of special financing instrument like convertible security (Preference share), (3) use of covenant, (4) syndication and (5) payoff structure of investor. The structure of financing, specification of control right and duties of both the parties are mentioned n the contract for smooth deal flow.

A typical feature of a contract involves:

(1) Intensive screening and evaluation process.

(2) Active involvement of VC (control and management Support).

(3) Staging of capital infusion.

(4) Use of special security for financing.

(5) Syndication.

Despite investment risk, VC investment generated attractive returns and created many leading portfolios like Skype, YouTube, Facebook, etc. (Gompers and Lerner, 2001; Cochrane, 2005). Such success of VC backed enterprises makes VC investment more attractive both to

investors and academic point of view. Venture investment has various unique characteristics and involves in several practices which have an influence on the deal success.

Investment in rounds, use of convertible securities, syndication and continuous controlling through different contractual parameter are various practices involved in VC investment, which has an impact on its success (Berglof, 1994; Gompers, 1995; Hellman, 1998a, b; Repulla and Suraz, 2004). Though the individual influence of each element of venture's success is difficult to measure the combination of all practices definitely influence the performance of the venture.

VC fund and venture capitalist make a special contribution to portfolio business for which it has been found that VC backed companies achieve higher success and outperform others in the form of sales, productivity, profit as well as research and development (Davis, Stetson, 1985; Ying-naa et al., 2013). Now VC fund becomes attractive in financial intermediation market for its promising return. Past research on VC investment has built classical VC theory (Tyebjee and Bruno, 1984; Sahlman, 1990; Bygrave and Timmons, 1992; Fried and Hisrich, 1994; Gompers and Lerner, 2001). These theories describe with appropriate screening of business proposal and its evaluation, structuring, monitoring are important steps of the investment process.

The structuring of the deal involves appropriate allocation of risk and control right through stage financing and using convertible securities (Berglof, 1994; Hellman, 1998a, b). This could manage risk and liquidity over time and provide value addition (Gompers, 1995; Cornelle and Yosha, 2003). With this, the type of industry, stage of investment, the size of investment and investment policy play an important role in VC decision process and its success outcomes (Tyebjee and Bruno, 1984; Ruhnka and Young, 1987; Fried and Hisrich, 1994).

It is well understood that in the case of VC investment success is defined as the profitable exit of the VC investor from the portfolio firm through IPO. Venture capitalist could also come out from the deal by several another mode of exit like M&A, Secondary sale, trade sale, etc. VC investment is a long term investment as its result comes out after the vintage period. So in the case of an ongoing deal with stage funding option the successful continuation of the deal is indicated through the amount of fund invested in subsequent rounds. Those continuing deal which receives more fund in subsequent round compared to previous round is considered as an interim success of the deal.

Venture investor goes for the next round of funding with higher investment amount if the portfolio firm meets their expected target level. Through this multiple rounds of funding venture investor intends to maximise their ownership percentage. This could lead to exercise the more controlling power of venture capitalist on portfolio firm avoid unutilized effort and increase value added activities (Podoynitsyna et al., 2013). Revenue generation and post evaluation of the entrepreneur firm is an indicator of efficient continuation of the VC deal.

Data and methodology
In this study, those VC deals taken as the observation which is either successfully exited or received more than one round of funding with the comparatively higher amount of fund than the previous round. Those deals which get a lesser amount of fund than previous one are not considered under the successful deal. All the VC deals taken as observation in this study occur during 2007–2015 and some of them are still continuing. Deals before this period are not taken in this study due to unavailability of complete information. Information related to VC investment is too confidential in nature. In Indian context getting relevant information related to a VC deal is a challenging thing. In such case study on the performance of Indian, VC deal is not too easy. But performance study of VC deal in the Indian context is very much required for future growth of VC industry.

Therefore this study has attempted to derive a performance model based on observable attributes of a VC deal. This success is supported by various aspects like deal characteristics, contract mechanism, noticeable deal outcome, etc.

Following is the list of a variable taken in this study with its definition (see Table 2).

In devising the model all observations (1,129) are not used. This analysis includes 130 1observations only including 83 successful, 43 unsuccessful and four undecideds (as the amount of investment in the subsequent round is equal). This study uses the C5 decision tree algorithm to 130 observations.

This study is based on the development of predictive classification for the success of a VC deal based on both qualitative and quantitative indicators. Various analytical tools like discriminate analysis, logistic regression, artificial neural network, principal component analysis and decision tree analysis are commonly used in the past literature for deriving the predictive model of success.

Decision tree algorithm is the most convenience analytical method in data mining due to its tree like structure which is easy to interpret. Therefore it is commonly used in various classification and estimation studies (Koyuncugil, 2007; Koyuncugil and Ozgulbas, 2008). In this analysis, the dependent variable could be both continuous and categorical. Decision tree applies multiple tests (decision tree algorithm) to data set for the best prediction of the dependent variable. This study applies decision tree analysis in SPSS modeller 18 for devising the success model of VC deal. Various deal characteristics are considered in this study as the observable component of success.

Decision tree derives its model from historical data and predicts the result for future value. This prediction feature is one of the important usages of the decision tree. In this analysis, categorical variable is efficiently collapsed and highly skewed variable are subdivided into ranges. Both categorical and continuous or nominal variable are handled by this analysis.

A decision tree is a most convenient and power full statistical tool for classification, prediction, interpretation and manipulation of data. Due to the following feature, this analysis gets a better advantage:-

(1) It simplifies the complex relationship between dependent and input variable and divides it into several sub group.

(2) Easy to interpret.

(3) It is not parametric in nature and doesn't assume any distributional approach.

(4) Without data transformation, it handles heavily skewed data.

(5) Robust to outliers.

The decision tree classifies the occurrences based on their feature value of instances. Several classification methods are used in this analysis. In this study, the C5 algorithm has been used for the classification of the instances.

C5 algorithm:
Just like ID3, C5 builds decision tree from the set of training data. This training data set consists of set of classified sample, i.e. $S = S_1 + S_2 + \ldots + S_n$.

Sample S_n consists of m dimensional vector (x1n, x2n. . .,xmn).

"n" is the number of samples.

"x" is the variable value of the sample and represent the class in which the sample will fall.

At every node, C5 splits the sets of sample into subset by choosing the most effective attribute. The splitting criterion is based on the difference of entropy or normalised

information gain method. Those attributes are chosen to make a decision which has highest normalised information gain.

Both continuous and categorical attributes are handled C5 algorithm. It creates a threshold value and makes the list of the two categories of attributes, i.e. value above the threshold value and value below the threshold value. It also handles missing value. Once the algorithm is created C5 prune the tree by replacing those attribute which doesn't help in classification. This could overcome the problem of over fitting and pruning error and better predict the relevant attribute.

After identification of variable, the variable importance is calculated based on reduction of accuracy of the model if the particular attribute is removed (see Table 3).

Result and interpretation

Result obtained from C5.0 decision tree analysis and interpretation

Figure 1 displays the scheme and Appendix states the cycle and rule steps of the scheme. From the model it can be seen that the classification of the decision tree model is based upon

Figure 1.
Scheme on classification rule obtained from C5.0 decision tree algorithm

variable like SYND (Syndication of the deal), INDT (type of industry of portfolio firm), RAMT (amount invested), POST_COMP (post company valuation of start-up firm after investment), INVT (type of investor), STKR (VC stake percentage), RREV (revenue generated by portfolio firm) and CONVS (security used with convertibility option). The success status of the VC deal can be interpreted by values obtained from the above attribute and their performance could be ranked.

From Figure 1 it is clearly seen that 32 different profile of VC deal could emerge as a result of the classification of different observation within the data set. These 32 deal profile has been summarised in Table 1 with a distinct threshold value of the variables.

The first two profiles (1 and 2) are determined by SYND variable. The first profile is formed from the observation having SYND value equal to "0". This constitutes 32 observations with only 46% of success rate. Therefore deal without syndication can be evaluated as unsuccessful.

The second profile is created from the observation having SYND value "1". This profile comprised of 98 observation out of which 68 observation are successful with 69% success rate. Therefore VC deal with syndication can be evaluated as successful. Again more information is required to designate a syndicated deal as successful or not. Further classification through other variable is required to draw the conclusion.

The further classification has been done by using another variable to get successful and unsuccessful deal profile. The following result can be interpreted as a successful profile from this analysis:

(1) Deal with SYND value "0" (on-syndicated deal) but belongs to IT & ITeS industry (INDT = 1) can be classified as successful profile as it is having 55% success rate (Node-5).

(2) Deals with SYND value "1" (syndicated deal) with POST_COMP value > 2.508 can be classified as successful (Node-13). There is 98 observation in this category out of which 68 (74%) are successful.

(3) Deals with SYND value "1", POST_COMP value > 2.508 and STKR value "2" can be classified as successful (Node-24). There is 80.6% success rate found in this category.

(4) Deals with SYND value "1", POST_COMP value > 2.508, STKR value "2" and RREV > 2.989 can be classified as successful as this category is having 42 successful deal out of 47 observation (Node-28). The success rate in this category is 90%.

Attribute	Symbol	Supporting literature
Type of industry	INDT	Sahlman (1990), Gomper and Lerner (1998)
Type of investor	INVT	Sahlman (1990)
Venture capitalists experience	VCEXP	Wang and Zhou (2004), Botazi et al. (2004)
Ownership of VC investor	STKR	Sahlman (1990)
Amount of investment of fund	RAMT	Gompers and Lerner (1998), Gompers (1995)
Use of convertible security	CONVS	Sahlman (1990), Kaplan and Stromberg (2003), Cumming (2005)
Syndication of deal	SYND	Admati and Pfleiderer (1994); Tian (2012); Hachberg et al. (2007), De Clercq and Dimov (2004)
Stage funding	STGF	Cornelli and Yosha (2003), Baker (2000), Neher (1999)
Post company valuation of portfolio company	POST_COMP	Woodward and Hall (2003)
Revenue generated	RREV	Jones et al. (2003); Hellman (1994)

Table 1.
Supporting the literature for attribute

Sl.no	Name of variable	Definition of variable
1	INVT	Type of investor. It returns value "1" for India based investor, "2" for foreign based investor and "3" for co-investment
2	VCEXP	The experience of a venture capitalist. This is the aggregate value of the total experience of all investor involved in a VC fund in no. of the year
3	RAMT	Real amount of fund invested in portfolio firm in (US$mn)
4	INDT	Industry type, it returns value "1" if the portfolio firm belongs to "IT & ITeS" industry and "0" otherwise
5	SYND	Syndication, it returns value "1" if the deal is syndicated and "0" otherwise
6	CONVS	Use of convertible securities. It returns value "1" if the security used in a VC deal is having convertibility option and "0" otherwise
7	STGF	Stage funding. Returns value "1" if investment happened in multiple rounds and "0" otherwise
8	STKR	Stake range. Returns value "1" if the percentage of stake holding by a venture capitalist in portfolio firm is less than 10%. "0" otherwise. It is derived from a percentage of stake holding of a venture capitalist. 10% has taken as the measure as beyond this percentage VC gets comparatively more control on portfolio firm
9	POST_COMP	Post company valuation of the portfolio firm after VC investment at a particular round in US$mn
10	RREV	Real revenue of portfolio firm after VC investment in US$mn

Table 2.
Definition of variable

(5) Deals with SYND value "1", POST_COMP value > 2.508, STKR value "1", RAMT ≤ 15.231 and RREV >1.140 can be classified successful as this category is having 87% success rate (Node-18).

(6) Deals with SYND value "1", POST_COMP value > 2.508, STKR value "2", RREV > 2.989 and CONVS value "1" can be classified as successful (Node-32). Under this profile, the success rate is highest, i.e. 95%.

So more over this decision tree model predict that syndicated deal with post valuation of the company higher than 2.508$mn, having more than 25% of VC holding in entrepreneur firm with revenue earning more than 2.989$in and used convertible security for investment can come out as successful.

In this analysis, the total observations are partitioned in 80% training and 20% testing data set. Figure 2 and 3 is the success graph based upon training and testing data set.

Figure 2 is the gain chart. In the gain chart, the uppermost line shows the possible highest level of accuracy. The area between the second line and 45-degree angle line is the indicator of the success of the node. The success of the model is directly proportional to the width of the area between the lines. According to the graph formed by C5 decision tree algorithm shown in Figure 2, the model devised from this analysis is effective in classifying the VC deal in the successful and unsuccessful category.

In lift chart, the effectiveness of a predictive model is calculated as the ratio between the results obtained with and without the predictive model. The success of the model is interpreted from the area between the baseline and lift curve. This area indicates the percent of a positive outcome (i.e. the success of the VC deal) in a given set of condition.

According to the result of this analysis, 81.31% are correct in training data and 77.78% are correct in testing data set. So this classification is efficient. The devised model can successfully classify the success of a VC deal. The overall success rate of this model for predicting the success of the deal profile is 90% (see Table 4).

Profile	Node	SYND	INDT	RAMT	POST_COMP	INVT	STKR	RREV	CONVS	VCEXP	RREV
1	1	0	0								
2	11	1	0								
3	2	0	0	≤3.46							
4	3	0	0	>3.46							
5	4	0	1								
6	5	0	1								
7	6	0	1		≤6.779						
8	10	0	1		>6.779						
9	7	0	1		≤6.779	1					
10	8	0	1		≤6.779	2					
11	9	0	1		≤6.779	3					
12	12	1			≤2.508						
13	13	1			>2.508						
14	14	1			>2.508						
15	24	1			>2.508		1				
16	15	1		≤15.231	>2.508	1	2				
17	16	1		≤15.231	>2.508	1	1				
18	17	1		≤15.232	>2.508	1	1	≤1.140			
19	18	1		>15.232	>2.508	1	1	>1.140			
20	19	1			>2.508	2	1				
21	20	1			>2.508	3	1				
22	21	1			>2.508	3	1				
23	22	1		≤10.192	>2.508	3	1				
24	23	1		>10.192	>2.508	3	1				
25	25	1			>2.508		2	≤2.989			
26	26	1			>2.508		2	≤2.989			≤2.252
27	27	1			>2.508		2	≤2.989			>2.252
28	28	1			>2.508		2	>2.989			
29	29	1			>2.508		2	>2.990	0		
30	30	1			>2.508		2	>2.991	0		
31	31	1			>2.508		2	>2.992	0	≤27	
32	32	1			>2.508		2	>2.993	1	>27	
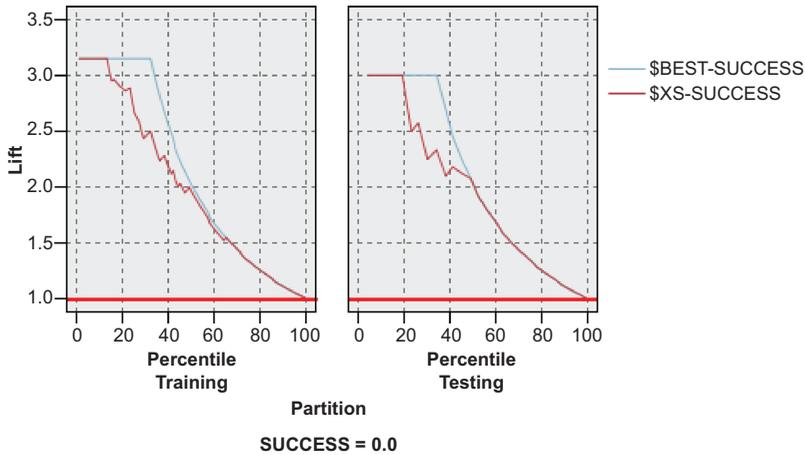
Table 3.
Company profiles
obtained from the
scheme formed by C5.0
decision tree algorithm

| Partition | 1_Training | | 2_Testing | | Table 4. |
	Number	Percentage	Number	Percentage	General accurate classification rates of
Correct	87	81.31	21	77.78	training and testing
Wrong	20	18.69	6	22.22	sets formed by the C5.0
Total	107		27		algorithm

Practical implication

The result of this analysis clearly indicates that the success of the deal does not only depend on the final outcome like POST_COMP and RREV but also depends on various observable contractual characteristics like syndication decision, use of convertible security and ownership percentage with some noticeable deal features.

This undoubtedly specifies that the importance of efficient financial contract is significant for successful exit or continuation of a VC deal. This contract involves proper allocation of

cash flow right and control right of a venture capitalist. A suitable control mechanism and compensation structure can mitigate the risk of moral hazard and asymmetry information problem (Cumming, 2005).

The expected return of VC could be realised by minimising the inherent risk of investment in start-up firm. The contract between the VC investor and entrepreneur has various clauses through which the inherent risk and probable conflict could be minimised. It is proved in this study that the successful deal profile is characterised by having an attractive outcome with the appropriate contractual mechanism.

This study increases the further scope of study on a contractual mechanism such as allocation of cash flow right and control right in the deal contract between venture investor and entrepreneur firm. This could give a better understanding of success path of a venture deal.

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Appendix
Cycle and rule steps of C5 algorithm model

```
syndicationornot = 0.000 [ Mode: 0 ] (32)
        industrytype = 0.000 [ Mode: 0 ] (14)
                RealamtinUS$m <= 3.461 [ Mode: 1 ] => 1.0 (4; 1.0)
                RealamtinUS$m > 3.461 [ Mode: 0 ] => 0.0 (10; 0.9)
        industrytype = 1.000 [ Mode: 1 ] (18)
                postcompvalueUS$ <= 6.779 [ Mode: 0 ] (11)
                        iinvestortype = 1.000 [ Mode: 0 ] => 0.0 (8; 0.75)
                        iinvestortype = 2.000 [ Mode: 1 ] => 1.0 (3; 1.0)
                        iinvestortype = 3.000 [ Mode: 0 ] => 0.0 (0)
                postcompvalueUS$ > 6.779 [ Mode: 1 ] => 1.0 (7; 0.714)
syndicationornot = 1.000 [ Mode: 1 ] (98)
        postcompvalueUS$ <= 2.508 [ Mode: 0 ] => 0.0 (6; 0.833)
        postcompvalueUS$ > 2.508 [ Mode: 1 ] (92)
                Stakerange = 1.000 [ Mode: 1 ] (30)
                        iinvestortype = 1.000 [ Mode: 1 ] (20)
                                RealamtinUS$m <= 15.231 [ Mode: 1 ] (18)
                                        Realrevenue <= 1.140 [ Mode: 0 ] => 0.0 (2; 1.0)
                                        Realrevenue > 1.140 [ Mode: 1 ] => 1.0 (16; 0.875)
                                RealamtinUS$m > 15.231 [ Mode: 0 ] => 0.0 (2; 1.0)
                        iinvestortype = 2.000 [ Mode: 0 ] => 0.0 (3; 1.0)
                        iinvestortype = 3.000 [ Mode: 1 ] (7)
                                RealamtinUS$m <= 10.192 [ Mode: 0 ] => 0.0 (3; 0.667)
                                RealamtinUS$m > 10.192 [ Mode: 1 ] => 1.0 (4; 1.0)
                Stakerange = 2.000 [ Mode: 1 ] (62)
                        Realrevenue <= 2.989 [ Mode: 1 ] (15)
                                Realrevenue <= 2.252 [ Mode: 1 ] => 1.0 (9; 0.778)
                                Realrevenue > 2.252 [ Mode: 0 ] => 0.0 (6; 0.833)
                        Realrevenue > 2.989 [ Mode: 1 ] (47)
                                convsec = 0.000 [ Mode: 1 ] (7)
                                        yearofexpofvc <= 27 [ Mode: 1 ] => 1.0 (4; 1.0)
                                        yearofexpofvc > 27 [ Mode: 0 ] => 0.0 (3; 1.0)
                                convsec = 1.000 [ Mode: 1 ] => 1.0 (40; 0.95)
```

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