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What determines Venture Capital investment decisions? Evidence from the emerging VC market in Egypt

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ABSTRACT

The decision of a venture capitalist to commit capital in a new risky business is a complex decision. Investors need to consider a number of important criteria simultaneously. Based on the postulates of signaling theory and the investment criteria outlined in the extant literature, we propose a theoretical framework to describe the relationship between a new venture's characteristics and the funding decision. The proposed framework is tested using actual data of a unique sample of 200 new Egyptian technological startups. The startups were tracked from establishment until applying to a venture capitalist and a decision was made either to accept or to reject them. Logistic regression analysis reveals that venture capitalists prefer to invest in startups with mature products and actual financial performance. The entrepreneurs' industry experience and the size of their social networks are important factors that affect the startup's access to finance. Using decision tree analysis to map venture capitalists' decisions, we show that the time of applying for funds is critical and serves as a gateway for further evaluation. Startups are more likely rejected for applying later into the venture capital fund than for lack of experience or unproved products. This suggests that the development of the Egyptian tech ecosystem may be hugely constrained by the limited availability of capital as well as the high aversion to risk on behalf of venture capitalists.

Keywords: venture capital, selection criteria, tech startups, entrepreneurial finance, Egypt

1. Introduction

Venture capital is an important source of entrepreneurial finance. In addition to obtaining the needed funds to support their growth, startups also benefit from the venture capitalists' business acumen, networks and various other valuable resources. Over the past forty years, the VC industry in the US has proved to be very efficient, creating a large number of very successful companies. This has led other countries around the world to copy the US VC model, although the emergent models are not without their own variations. Despite the widespread and growth of VC worldwide, the majority of new companies are often unsuccessful in getting funded by venture capitalists (VCs hereafter).

This has directed much research effort to identify how VCs select their investments. Empirical research revealed a number of important criteria that VCs use in the process of selecting their investments. clude market attractiveness, product differentiation, managerial capabilities (Chorev & Anderson, 2006; Tyebjee & Bruno, 1984), long-term growth and profitability of the industry (Hall & Hofer, 1993), preferences of VCs to invest earlier or later

along a firm's life cycle (Gompers, 1997) as well as the probability of a successful exit (Tyebjee & Bruno, 1984).

In Egypt, increased attention is being directed to promote innovation and entrepreneurial firms to promote economic conditions. Several proactive policies and programs are now in place to facilitate registering, establishing and development of new firms (Alsharif, 2015). Although the size of venture capital investments in Egyptian startups is increasing, little is known about how VCs make investment decisions and what characteristics do they look for in a new venture. By proposing and testing a theoretical framework that links criteria identified in the literature to the VC investment decision, the study contributes to the understanding and theorizing of venture capital decision-making in general, while also evaluating how the Egyptian environment could have shaped VC investment criteria.

Venture capital decision-making has been extensively described in the literature by many researchers, nonetheless, it remains under-theorized (Alemany & Villanueva, 2015). Numerous studies investigated the investment criteria that VC considered important in evaluating and selecting startups. Studies by Tyebjee and Bruno (1984), MacMillan et al. (1985, 1987), Silva (2004), Zhang (2007) and Gompers et al. (2010) among others show that VCs investing in newly-formed startups prioritize factors related to the entrepreneur/management team, factors related to the market potential followed by those related to the product/service offering. After this 'startup' stage, the evaluation of ventures in the 'early-growth' stage is more focused on financial aspects such as profit margins, costs of scalability of operations and exit possibilities.

Despite the extensive research on VC selection and evaluation criteria, there is inconclusive evidence that these criteria will actually generate higher subsequent performance or superior growth for the new venture (Alemany & Villanueva, 2015). Linking the criteria of VC funding and subsequent performance, however, is necessary for the development of theory. Petty and Gruber (2011) propose that this missing link is the result of the methodology used in prior research. Researchers first conducted surveys and interviews where venture capitalists were asked to rank different criteria according to their importance in shaping the investment decision (Sharma, 2015). Results showed that the characteristics of the entrepreneurial team, the characteristics of the product and the market opportunity were considered of top priority, followed by the financial aspects of the deal. However, these studies often contradicted as to which category ranked before the other. Results were also prone to self-reporting errors and post-hoc rationalization (Petty & Gruber, 2011) as well as recollection mistakes (Alemany & Villanueva, 2015; Shepherd & Zacharakis, 1999). In addition, VCs might have been more likely to report criteria that should be used rather than criteria they actually used (Nunes et al., 2014; Sharma, 2015).

Other researchers used verbal protocols (Sandberg et al., 1988), where the real-time capturing and analysis of venture capitalists' decision processes allowed researchers to unravel the investment criteria that were actually 'in use'. Believed to be more accurate, these studies suggested that venture capitalists may 'lack insight' into their own decision-making (Shepherd, 1999; Zacharakis & Meyer, 1998). However, verbal controls were not without their own limitations.

They were often limited to a smaller number of cases and were prone to the subjective interpretation of the researcher (Alemany & Villanueva, 2015). The next wave of studies, which were experiment-like and used conjoint analysis, were criticized for having low validity, impracticality and oversimplification. The experiments focused on one stage of the decision-making process as opposed to the dynamic settings in which VCs make investment decisions, therefore they provided an incomplete understanding of the investment criteria that were critical for venture capitalists (Petty & Gruber, 2011).

2. Theoretical foundation and hypotheses development

The role of signaling is established in the study of entrepreneurship. Evidence shows that the intensity and importance of a signal are positively related to the size of informational gaps that exist in the market. Entrepreneurial companies are characterized by huge uncertainty and high failure rates (Gompers et al., 2016). At the earlier stages, the company's assets are intangible and centered on the innovative ideas and skills of the entrepreneur. Before selecting their investments, venture capitalists typically expend great effort and time in gathering information to overcome informational gaps and to reduce opportunistic behavior as much as possible (Zacharakis & Meyer, 1998).

Signaling theory may explain why venture capitalists rely on the information they gather about entrepreneurs to predict whether a venture will be successful. It is a real challenge to identify competent management that would be able to generate high performance. Because of the uncertainty surrounding a new startup, at the time of assessment, venture capitalists rely on the observable attributes that are 'presumably correlated to unobservable determinants of quality' (Hoenig & Henkel, 2015).

2.1 Criteria related to the quality of the entrepreneurial team

MacMillan et al. (1985) show that the most important criteria to the venture capitalist are the entrepreneur's personality and experience. The study by Bhide (2000) showed that most successful entrepreneurial ideas came to founders while working with prominent past employers. According to Hsu (2007) and Zhang (2007), serial entrepreneurs not only have higher chances of being selected by venture capitalists but they also raise higher amounts of funding in their earlier rounds. Zhang (2007) explains that the superior performance of serial entrepreneurs may result from their ability to 'learn by doing' which enhances their entrepreneurial skills as well as the important connections that they have established in previous founding experiences particularly with VCs, and which may become beneficial in the future.

Similarly, Gompers et al. (2016) show that the quality of management and management commitment are the criteria receiving the highest weight in the assessment of proposals and attribute the likelihood of investment success or failure to the entrepreneur rather than to the market or the business itself. Entrepreneurs' characteristics included among the highest valued criteria alternate between experience, skills, personality, enthusiasm and past entrepreneurial success (Gompers et al., 2010; Zhang, 2007; Silva, 2004). In the study by Bernstein et al. (2017) show that investors react most strongly to the information about a startup's founding team then to traction and prior investors.

Social capital and network relationships are important for entrepreneurs and may improve their chances of securing funding to their ventures. In uncertain environments, investors are more likely to place greater weight on the attributes of founders relative to other aspects of the business. When deciding to fund a startup or an early-stage venture, the quality of the entrepreneurial team is expected to be of critical importance for venture capitalists. However, venture capitalists cannot possibly judge new entrepreneurs using characteristics such as ‘integrity’, ‘passion’, ‘work ethics’ and ‘leadership’ without actually entering into a working relationship with them. These criteria cannot be observed during decision-making. On the other hand, entrepreneur’s industry experience and education are objective measures. Likewise, the completeness of the team where important positions are filled is also objective. Therefore we formulate the following hypotheses about entrepreneurs using objective characteristics

H 1: Entrepreneurs' characteristics are important criteria that affect venture capitalists' investment decision making.

H 1.1: The quality of entrepreneur's education has a positive effect on the funding decision

H 1.2: Prior industry experience has a positive effect on the funding decision

H 1.3: Diversity in the entrepreneurial teams' education/background have a positive effect on the funding decision

H 1.4: The size of the entrepreneur's social network has a positive effect on the funding decision

H 1.5: Entrepreneurs' commitment has a positive effect on the funding decision

2.2 Criteria related to the product

Despite the predominance of the criteria related to the entrepreneur in VC investment decision making (Gompers et al., 2016), those related to the product and to the market are found to be equally important, as witnessed by previous studies (Hall & Hofer, 1993; Rah et al., 1994). Other important criteria were related to the business proposition; whether the business is scalable and has high sustainable growth potential (Hellmann & Puri, 2000; Kaplan et al., 2009), also those related to the product/service offering and the technology supporting the product; criteria related to the market potential and level of competition (Gompers et al., 2016), and criteria related to the developmental stage of the venture (Pries, 2001). Although part of the fame earned by US VC was because of their endorsement to some of the most innovative ideas and revolutionary technologies, in less developed, less stable economies VC may shy away from ventures with novel, untested products or innovative value propositions where the underlying technology is yet to be proved. Venture capitalists may prefer investing in ventures that already have had some success in the market or resemble others that proved to be successful, in other words, ventures that are commercially viable. Accordingly, the following hypotheses are tested:

H 2: Product/service characteristics affect venture capitalists' investment decision making.

H 2.1: Commercialized products (early validation) have a positive effect on the funding decision

H 2.2: Products/services that resemble past successes have a positive effect on the funding decision

2.3 Criteria related to the market opportunity

Studies also show that venture capitalists prefer to invest in tested products given there is still room for new market players. Several researchers provide evidence that market characteristics, such as the degree of competition and ease of entry are important investment criteria for venture capitalists (Gompers et al., 2016; Nunes et al., 2014; Simic, 2015). Their logic is obvious; for VCs to ascertain handsome returns on their investment, a venture needs to compete in a large and a growing market (Fried & Hisrich, 1994; Nunes et al., 2014; Petty & Gruber, 2011; Simic, 2015). In addition, the presence of a developed customer base proves that the startup is accepted in the market. We test whether the growth rate of the target market and an existing proof of market acceptance are important criteria for VC.

H 3: Market characteristics are important criteria that affect venture capitalists' investment decision making.

H 3.1: Higher growth in the startup target market has a positive effect on the funding decision

H 3.2: Proof of market acceptance has a positive effect on the funding decision

2.4 Availability of financial information

Venture capitalists take into consideration a large amount of intangible and subjective information about early stage startups (Armandi, 2015; Gompers et al., 2016; Sharma, 2015; Wright & Robbie, 1998). For obvious reasons, financial information about the new venture is greatly lacking. The high degree of uncertainty often leads to a wide discrepancy between entrepreneurs' own financial projections, VC projections and subsequent actual performance. Forecasting then discounting cash flows is extremely difficult when a venture has not yet generated profits or revenues, and would lead to inaccurate estimates of a startup true value (Gompers et al., 2016). Nonetheless, if available, financial information help VCs greatly when making evaluations of a potential investment (kohn, 2018). Venture capitalists prefer to base their projections on actual revenues and cash flows rather than depend on the projections supplied by entrepreneurs that are not based on actual data.

H 4: Disclosure of positive revenues has a positive effect on the funding decision.

2.5 The Relationship between VC and Prior Investors

Angel investors fund startups at the very early stages of development. Angels are typically former entrepreneurs who provide much needed expertise and post-investment mentoring to nascent companies, although the size of their investment is relatively smaller than that of VC (Mason & Harrison, 1996; Wiltbank et al., 2009). Researchers suggest that investment decision-making of angel investors and venture capitalists might be similar, however, the relationship between them with regard to a single investment remains under-researched. Mason and Stark (2004) suggest that angel investors' experience, hands-on management, active coaching and other value-adding activities can reduce moral hazard and elicit a relationship of trust. The study by Wong et al. (2009) reveals that the roles of angel investors and venture capitalists complement

each other. The study also shows that professional networks of angel investors can help entrepreneurs access VC funds faster.

In emerging markets, the relationship between angel investors and venture capitalists is less clear. Little is known on whether prior funding by angel investors is regarded positively by the venture capitalist. A co-investment strategy between angels and venture capitalists may, in theory, help reduce the severity of economic and market conditions through spreading the risks (Scheela et al., 2015). While the involvement of one angel investor may be observed as a good signal, receiving many rounds of seed funding may not. The presence of more investors means that the new startup has relinquished a larger portion of its equity (Ibrahim, 2013). This can deter venture capitalists from investing because returns of all investors will be reduced. Based on the previous argument, to test whether prior investments affect the VC's decision to fund a new startup, the following are hypothesized:

H 5: Involvement of prior investors has a positive effect on the funding decision

2.6 The Role of VC Experience and Stage of the VC Fund in Startup Selection

A number of studies have examined the effect of VC-specific factors on the VC decision-making process (Kaplan & Stromberg, 2000; Mishra et al., 2017; Rakhman & Evans, 2005). However, there are inconclusive evidence on how VC-specific factors impact venture selection. The venture capitalist industry experience and educational background are among the most researched factors. Gompers et al. (2008) study VC cycles and show that experienced venture capitalists are more sensitive to favorable public market signals and respond by increasing their investments more readily than venture capitalists with less experience and those experienced in different industries. Franke et al. (2008) find differences in the ranking of investment criteria between more and less experienced venture capitalists. Whether a match between the industry expertise of the VC and the industry of the new startup actually affected the final funding decision was not examined.

More recently, Cox et al. (2017) suggest that an 'investment paradox' exists when fundamental criteria about the team, the product and the market are met but investors are still unwilling to invest in a new venture. They show that the relationship between the business angels' criteria and the overall investment potential of a new venture is moderated by the business angels' industry experience. The present study tests the hypotheses that a fit between VC-related factors and a new investment actually moderates the relationship between the fundamental criteria and the decision to invest. Possessing the relevant industry experience can help investors evaluate the entrepreneur's capabilities more accurately, communicate better with the venture's management team and eventually add more value to the new venture. Accordingly, the following hypothesis is formulated:

H 6: VC industry experience positively moderates the relationship between the startup characteristics and the funding decision

In addition to VC industry experience, characteristics of the VC fund can determine whether a specific investment will be accepted or rejected by the venture capitalist. A good

investment opportunity may still be rejected for a number of reasons including a misalignment with the VC fund strategy or with the fund remaining life. A venture capitalist with a strategy to diversify across industries may select different investments to a venture capitalist that wants to create synergistic value between portfolio companies. In addition, VC investments are eventually cashed out/liquidated to provide returns to LPs. Therefore upon approaching the end life of the fund, VC may seek quicker profits and are more likely to invest in the fewer ventures that can be exited from quickly. Startups requiring a longer time frame to achieve a successful exit will be rejected regardless of management quality and the attractiveness of products and/or markets. This means that startups have higher chances of getting funded around the beginning of a new VC fund.

H 7: The VC fund maturity negatively moderates the relationship between the startup characteristics and the funding decision

The hypotheses stated above test some of the already examined relationships in previous studies. However, instead of relying on the ratings of the venture capitalists themselves that were provided in surveys and interviews or extracted from venture capitalists' executive summaries, the present study reformulated these relationships as hypotheses to be tested using actual data about startups' entrepreneurs, products/services and markets. Similar hypotheses were tested to predict subsequent venture (financial) performance (Alemany & Villanueva, 2015), to distinguish high-flyer exits from non-high-flyer exits (Streletzki & Schulte, 2013) but not to predict the funding decision which is examined here.

In previous studies, researchers used criteria such as the expected rate of return, size of the investment, exit opportunities, among others to investigate the importance of the financial aspects of the deal. We test the relationship between the disclosure of positive revenues and the funding decision (H4) to reflect a number of attributes about the startup. First, the degree of uncertainty about the startup is reduced and venture capitalists could base their evaluations on more reliable information. Second, the stage of the startup is accounted for to show whether the venture capitalist supplying the first round is more inclined to select post-revenue startups. This may reflect a higher degree of risk aversion for venture capitalists investing in Egypt. By proposing that characteristics of the venture capital fund moderate the relationship between the characteristics of a startup and the final funding decision (H6 and H7), we build on the findings of Petty and Gruber (2011) who reported that fund-related characteristics, such as 'inappropriate timing', 'no remaining fund for region', and 'competition with existing portfolio' were basis for deal rejection.

Drawing on multiple theoretical relationships, the proposed framework (Figure 1) combines the important criteria outlined in the literature to represent a unique view to venture capital decision making as a complex process. Further research could test the relevance of different sub-criteria according to the context.

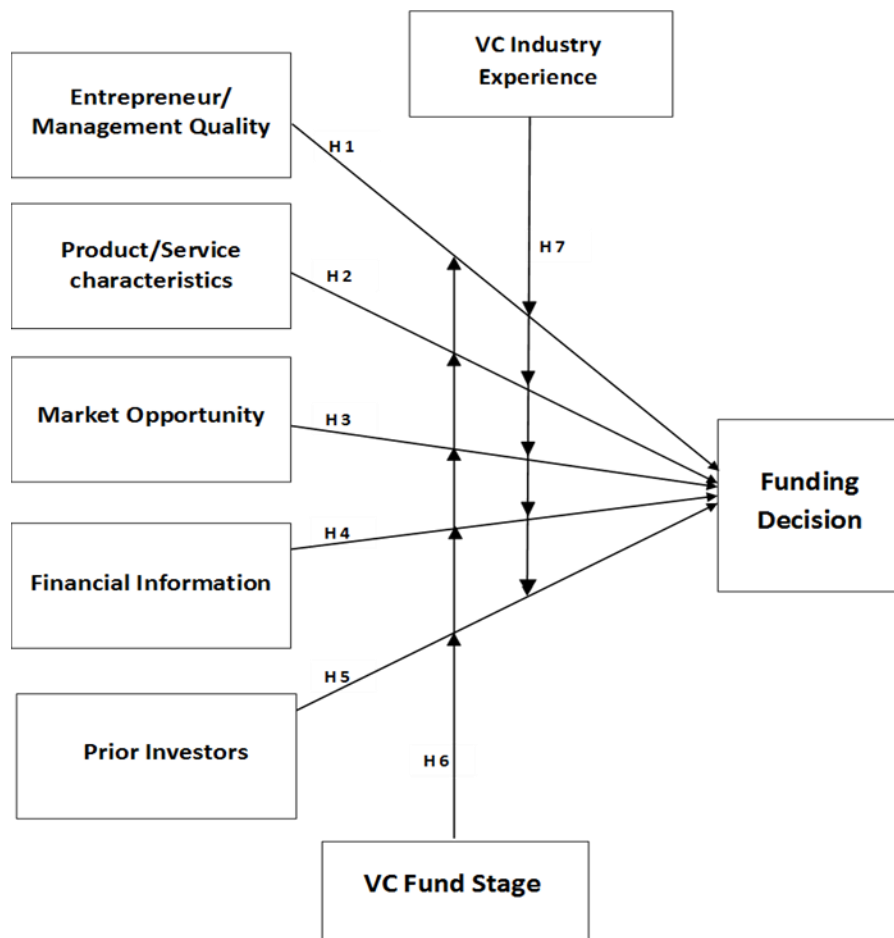


Figure 1 A framework to explain the relationship between VC Investment Criteria, VC Characteristics and the Funding Decision

3. Method and data collection

One of the main contributions of the present study is that it overcomes the limitations of prior works by employing a different approach to study venture capitalists' investment decisions. Instead of interviewing venture capitalists, the actual data about 200 Egyptian startup ventures, their entrepreneurial teams, products and markets were collected and analyzed. The convenience sampling approach was used¹ and the information about the startups were hand-collected from a variety of sources. Information about new startup founding and VC and angel funding were obtained from the websites of CrunchBase, AngelList, and Startup Ranking as well as from news clips, business articles, and the websites of venture capital firms.

Information about entrepreneurs' education and experience were obtained from LinkedIn. Reports published by MENA Private Equity and Venture Capital Association and the electronic

¹ Although randomness would have been preferable in order to render conclusions more generalizable, the sample constituted one third of the startups listed on AngelList (around 620 startups) by end of 2018.

portals of Magnitt and VCAfrica were used to gather information about the availability of VC funds and the investments that took place each year. Special attention was given to include only startups for which all the needed information is available and verifiable. Startups with missing information were replaced. Each company was tracked from the year it was established, through important events and activities until the end of 2018. The startups were established between 2004 and 2017. Table 1 shows the industry and age of startups in the sample.

Table 1 Number and age of startups by industry

<i>Industry Classification</i>	<i>Total</i>	<i>VC- Funded</i>	<i>Av. Age (yrs)</i>
Advertising & Marketing	8	0	7.71
Agribusiness	4	1	5.68
Business Services & Enterprise Software	10	2	6.16
Consumer Services	8	2	4.12
Delivery & Logistics	3	1	3.70
E-commerce	34	16	5.59
Education	12	3	3.94
Energy & Clean tech	5	2	6.25
Financial services	15	7	4.47
Healthcare	14	5	4.77
HR & Recruitment	5	2	6.52
Manufacturing (B2B)	1	1	6.28
Media & Entertainment	12	4	5.89
Network & Community	16	2	5.96
Real Estate	2	2	5.74
Transportation	10	4	4.95
Technology & IT solutions	37	10	5.05
Travel & Tourism	4	0	5.41
Total	200	64	5.20

Startups classified by type of seed funding received prior to applying to obtain VC funds are shown in Table 2. All percentages are calculated for the total sample (N=200). A relatively higher percentage of VC-funded startups had no prior investors followed by those which attended acceleration/incubation programs. Out of the sampled 200 startups, 64 startups (32.5%) received VC-backing, 19 startups (9.5%) received angel investments whether solely or in addition to being accelerator-backed. Similarly a total of 105 startups (52.5%) received investments from accelerators/incubators, 10 of which (5%) have also received angel investments. A very small number of startups received grants or financial prizes through the participation in startup events. The awarded sums of money in such events are often miniscule compared to what is needed to start a business. In addition, founders would need to invest their own funds initially to build a working prototype in order to compete in such events.

The frequencies and percentages of important characteristics observed in the sample are shown in Table 3. Each of these characteristics is represented by a binary variable that takes the value of 1 if the characteristic is observed in the startup, and zero if it is not observed. Percentages are calculated based on the column total. A larger difference between the two groups exists for industry experience, and possessing a ready product, as well as generating revenues. Endorsement is the only variable that was observed more in the non VC-funded group. The majority of startups in the sample had committed teams (71%) and products which had some initial level of market

acceptance (73%). The average number of engagements is higher in the funded group (bottom line).

Table 2 Type of Seed Funding Received Prior VC

<i>Type of Seed Funding</i>	<i>VC-funded</i>	<i>Non VC- funded</i>	<i>Total</i>
Accelerator/Incubator-backed	21 (10.5%)	74 (37%)	95 (47.5%)
Angel investors only	3 (1.5%)	6 (3%)	9 (4.5%)
Accelerator & Angel investors	5 (2.5%)	5 (2.5%)	10 (5%)
Grants/prize Only	3 (1.5%)	12 (6%)	15 (7.5%)
None	32 (16%)	39 (19.5%)	71 (35.5%)

Table 3 Frequency of Observing Important Characteristics in the Sample

	<i>VC-funded</i> <i>N=64</i>	<i>Non VC- funded</i> <i>N=136</i>	<i>Total</i> <i>N=200</i>
Education (Foreign)	37 (58%)	67 (49%)	104 (52%)
Industry Experience	46 (72%)	31 (23%)	77 (39%)
Team (Diversity)	33 (52%)	55 (40%)	88 (44%)
Commitment	57 (89%)	85 (63%)	142 (71%)
Past Success	39 (61%)	62 (46%)	101 (51%)
Product Stage	47 (73%)	28 (21%)	75 (38%)
Market Growth (High)	33 (52%)	53 (39%)	86 (43%)
Market Acceptance	59 (92%)	86 (63%)	145 (73%)
Revenue	52 (81%)	43 (32%)	95 (48%)
Endorsement	29 (45%)	85 (63%)	114 (57%)
Engagement (average)	3.28	2.49	2.74

4. Variables and measurement

The following section describes the variables of the study and explains how they are measured.

Variables	Description	Measurement
Independent Variables		
1- Characteristics of the Entrepreneurial Team		
1.1 Education	Type of education received by the lead entrepreneur(s).	Dichotomous Variable 1= foreign / international education ² 0 = otherwise

² Foreign education received in Egypt or abroad is regarded as superior to the national education. According to the Global Entrepreneurship Monitor 'GEM Egypt report 2012, the national education system is one of the major constraining factors to the development of entrepreneurial ecosystem in Egypt.

1.2 Experience	Entrepreneurs possess - <i>Industry</i> experience if they have worked for a company in the same industry for at least 5 years	Dichotomous Variable 1= previous experience 0= no experience
1.3 Background Diversity (team)	Whether members of the entrepreneurial team have different backgrounds representing important functional areas e.g. production, marketing/sales, etc.	Dichotomous Variable 1 = diverse background 0= similar background
1.4 Commitment	Entrepreneur devotes entire time to the startup (e.g. does not hold other jobs at overlapping dates with the startup establishment or quit original job to establish startup). ³	Dichotomous Variable 1 = committed 0 = not committed
1.5 Size of Social Network (Engagement)	The number of startup events and engagements in which the startup has participated prior to the application for funds	Continuous (Number)
2- Product/Service Characteristics		
2.1 Product Stage	Marking the developmental stage of the startup's product at the time of application for funds. ⁴ Products are divided into fully developed products that are ready to be commercialized and products that still need further development	Dichotomous Variable 1 = fully developed 0 = not fully developed
2.2 Product Novelty	Whether the product resembles another that is a proven past success or is completely new	Dichotomous Variable 1 = past success 0 = new
3- Market Characteristics		
3.1 Market Growth	The growth in the startup primary market indicates how promising the business opportunity will be. Markets are divided to high-growth and low-growth. ⁵	Dichotomous Variable 1 = high growth 0 = low growth

³ Only time commitment was included in the analysis. Almost all founders in the sample used their own funds (or funds of family and friends) at some time during startup establishment, therefore financial commitment was not considered.

⁴ A startup is often in continuous need of funding along a series of processes where it first develops a prototype, then tests a product, then enters a pre-production stage to test the market, eventually producing and selling a successful product. The venture capitalist may choose to wait until a product reaches a certain stage before investing.

⁵ First the actual market growth rates were obtained from official industry reports produced by Ministry of Communication and Information Technology (MCIT) or (General Authority for Investment & Free Zones) GAFI. However, these growth rates apparently lacked consistency. Therefore another measurement for *market growth* is used; the ranking of markets based on the growth in the yearly number of VC deals made by MENA investors. These rankings were obtained from reports issued by the MENA Private Equity and Venture Capital Association and had the same way of calculation each year. Higher-growth markets included Fintech, E-commerce, Delivery & logistics, Transportation, Technology & IT solutions, Education, Health care and Consumer services. Lower-growth markets included Advertising & marketing, Agribusiness, Business services, Energy & clean tech, Recruitment, Manufacturing, Real Estate, Network & community, Travel & tourism and Manufacturing.

3.2 Market Acceptance	An existing customer base indicates a startup is already accepted in the market (market validation)	Dichotomous Variable 1= customer base developed 0 = no Customer base
4- Financial Information Availability		
4.1 Revenues	Dividing startups according to whether they generated positive or negative revenues at the time of applying for VC funding	Dichotomous Variable 1= generating positive revenues 0= zero or negative revenues
5- Prior Investors		
5.1 Endorsement	- Whether a startup has received a prior round of seed investment (measured as a binary variable in the logistic regression).	Dichotomous Variable 1 = received funding from a prior investor 0= didn't receive
Moderators		
6- VC Industry Experience	Whether the venture capitalist has prior experience in the industry of the startup ⁶	Dichotomous Variable 1= VC experienced in the startup industry 0 = VC not experienced in the startup industry
7- Time into Fund	The stage of the VC fund at the time of the startup evaluation	Number of years that passed from the start of fund prior to the startup application
Dependent Variables		
Funding Decision	Whether the venture capitalist decides to invest in the startup	Dichotomous Variable 1= startup funded (selection) 0= startup not funded (rejection)

⁶ Experience of the venture capitalist came from prior investments made in the same industry as that of the startup being evaluated.

5. Analysis and Results

Logistic regression was used to test the effect of the investment criteria on the funding decision. Three models are tested and the results are shown in Table 4. Model 1 included eleven independent variables with no interaction effects: education, industry experience, team, commitment, engagement, ready product, past success, market acceptance, market growth, revenues, and endorsement. The estimated coefficients of the variables, standard errors and odds ratio are presented. The likelihood ratio for the joint significance of the explanatory variables is estimated using the chi-square test, where χ^2 is 114.055, p -value ≤ 0.01 . The variables: industry experience, engagement, ready product, market growth, and revenue have significant coefficients (p -value ≤ 0.05).

In the second and third runs of the LR (model 2 and model 3), in addition to main effects, the moderation effects of 'VC experience' and 'time into VC fund' are tested by adding interaction terms which combine these moderating factors with the independent variables. The two models are statistically significant, but none of the coefficients of the interaction terms are of statistical significance. This indicates that there are no combined effects for the variables included in the interaction terms, however, VC experience and time into fund are significant independently and are thus important on their own, not through their interaction components. Thus we reject hypothesis 6 which states that VC industry experience positively moderates the relationship between the startup characteristics and the investment decision and also reject hypothesis 7 which states that the VC fund maturity negatively moderates the relationship between the startup characteristics and the investment decision.

When testing the moderation of VC experience (model 2) and time into fund (model 3), the models were liable to over-fitting, as the variables were augmented with the interaction terms and might have caused the interaction terms to have insignificant coefficients. After eliminating interaction terms, another LR is run (model 4) using 'VC experience' and 'time into fund' as independent variables, in addition to the independent variables from model 1. Results are shown in Table 5. The Nagelkerke R-square ranges from 0 to 1 and approximates how much variation in the outcome is explained by the variables in the model (Field, 2008). It also gives an indication on the predictive power of the LR. Model 4 explains approximately 76% of the funding decision and therefore it does relatively well in explaining which startups receive funding. There are five variables in the model that significantly influence whether a startup gets VC funding or not. The variables with the statistically significant effect are industry experience, ready product, revenue, engagement and time into fund.

For the categorical variables, the table shows the β coefficient of industry experience is positive (2.267) and significant at the 1% level, indicating that possessing industry experience is associated with increased odds of achieving funding. The odds ratio (OR) show that entrepreneurs with industry experience are almost 10 times more likely (9.651 times) to get funded than their unexperienced counterparts. Therefore hypothesis 1.2 that states prior industry experience has a positive effect on the funding decision is accepted. Ready product is another important factor. Its coefficient is positive (1.615) and significant at the 5% level. Its OR indicates that startups with ready products are 5 times more likely to get funded than startups whose products are still undeveloped. Therefore hypothesis 2.1 which states that commercially viable products/services have a positive effect on the funding decision is accepted.

Table 4 Logistic regression results before and after introducing moderator variables

Variable/ Main effects	<i>Model 1</i>			<i>Model 2</i>			<i>Model 3</i>		
	β	S.E	OR	β	S.E	OR	β	S.E	OR
Intercept	-7.22***	1.336	.001	-2.635***	1.1859	.072	-13.344*	5.1914	1.602E ⁻⁶
Education	-.031	.461	.969	.238	.6846	1.268	1.665	3.1518	5.287
Industry Experience	2.223***	.450	9.232	2.754***	.7969	15.700	6.651**	2.8458	773.187
Team	-1.61	.448	.852	.278	.6936	1.320	4.931*	2.8118	138.503
Commitment	.275	.622	1.317	-.307	1.0653	.736	-3.182	4.3927	.041
Engagement	.154**	.072	1.167	-.177**	.0947	.838	-.644	.6643	.525
Ready Product	2.038***	.4789	7.677	1.867***	.8278	6.469	3.118	3.6110	22.601
Past Success	.741*	.455	2.099	1.074**	.7322	2.928	-.050	3.2416	.951
Market Growth	.659**	.330	1.933	-.647***	.6584	.524	-.892	3.0053	.410
Market Acceptance	.066	.710	1.068	.225	.8958	1.253	-1.329	3.4808	.265
Revenue	.1.182**	.538	3.261	2.031**	.7765	7.620	3.366	3.1238	28.971
Endorsement	-.681	.476	.506	-.276	.7947	.759	-1.772	2.7327	.170
Interaction Effects									
VC Exp				.066***	1.8475	1.068			
VC Exp * Education				-.802	1.0934	.448			
VC Exp * Industry Experience				.255	1.1816	1.290			
VC Exp * Team				-.140	1.0653	.870			
VC Exp * Commitment				1.843	1.6608	6.319			
VC Exp * Engagement				.001	.1363	1.001			
VC Exp * Ready Product				.591	1.0877	1.805			
VC Exp * Past Success				.090	1.0462	1.095			
VC Exp * Market Growth				1.700*	1.1000	5.477			
VC Exp * Market Acceptance				1.108	1.7434	3.030			
VC Exp * Revenue				-1.889*	1.0840	.151			
VC Exp * Endorsement				-.660	1.1090	.517			
Time into Fund							4.717**	1.9048	111.824
Time into Fund * Education							-.563	1.2078	.053
Time into Fund * Industry Experience							-1.373	.9882	.253
Time into Fund * Team							-2.567*	1.1830	.077
Time into Fund * Commitment							1.161	1.8018	3.192
Time into Fund * Engagement							.130	.2368	1.139
Time into Fund * Ready Product							.010	1.3943	1.010
Time into Fund * Past Success							.267	1.3226	.098
Time into Fund * Market Growth							-1.069	1.2468	.343
Time into Fund * Market Acceptance							.320	1.3005	.108
Time into Fund * Revenue							-.637	1.1531	.529
Time into Fund * Endorsement							.192	.9954	1.212
Omnibus test									
Likelihood Ratio Chi-Square		114.055***			135.438***			174.700***	
Goodness of Fit									
Log Likelihood		-68.346			-57.655			-38.024	
Akaike's Information Criterion (AIC)		162.693			167.310			128.047	

Level of significance: *: $p \leq 0.1$; **: $p \leq 0.05$; ***: $p \leq 0.01$

Revenues is also positive (1.323) and significant at the 5% level and OR indicates that revenue generation increases the likelihood of getting funded by 3.755 times. Hence we accept hypothesis 4 which states that the availability of financial information has a positive effect on the funding decision.

In Model 4, two continuous variables are significant; engagement and time into fund. The coefficient of engagement is positive and significant, although very small (0.189). The OR indicates that for every one-unit increase in engagement, we expect a 1.2 increase in the log-odds of getting funded, holding all other independent variables constant. Accordingly, we accept hypothesis 1.5 that states that the size of the entrepreneur's social network has a positive effect on the funding decision. In contrast, time into fund has a negative β coefficient (-2.144) and significant at the 1% level. The OR indicates that for every one-unit increase in VC fund maturity, the log-odds of a startup getting selected by VC drops by 0.117.

Table 5 Logistic regression results with main effects only

<i>Model 4</i>			
<i>Variable/ Main effects</i>	β	<i>S.E</i>	<i>OR</i>
Intercept	-2.085	1.787	.124
Education	.058	.603	1.060
Industry Experience	2.267***	.606	9.651
Team	-.940	.605	.390
Commitment	.056	.747	1.058
Engagement	.189**	.092	1.209
Ready Product	1.615**	.633	5.030
Past Success	.616	.594	1.851
Market Growth	.727	.474	2.069
Market Acceptance	-.0236	.825	.790
Revenue	1.323**	.743	3.755
Endorsement	-.880	.605	.415
VC Experience	.455	.588	1.576
Time into Fund	-2.144***	.423	.117
Omnibus test			
Likelihood Ratio Chi-Square	157.790***		
Goodness of Fit			
Log Likelihood	-46.479		
Akaike's Information Criterion (AIC)	120.957		
Cox & Snell R Square	.546		
Nagelkerke R Square	.764		

Level of significance: *: $p \leq 0.1$; **: $p \leq 0.05$; ***: $p \leq 0.01$

The following table summarizes the results of the hypothesis testing

H 1.1 The quality of entrepreneur's education has a positive effect on the funding decision	Rejected
H 1.2 Prior industry experience has a positive effect on the funding decision	Accepted
H 1.3 Diversity in the entrepreneurial teams' background has a positive effect on the funding decision	Rejected
H 1.4 Entrepreneurs' commitment has a positive effect on the funding decision	Rejected
H 1.5 The size of the entrepreneur's social network has a positive effect on the funding decision	Accepted
H 2.1 A commercialized product (early validation) has a positive effect on the funding decision	Accepted
H 2.2 A product that resembles past successes have a positive effect on the funding decision	Rejected
H 3.1 Higher growth in the startup target market has a positive effect on the funding decision	Rejected
H 3.2 Proof of market acceptance has a positive effect on the funding decision	Rejected
H 4 Disclosure of positive revenues has a positive effect on the funding decision.	Accepted
H 5 Involvement of prior investors has a positive effect on the funding decision	Rejected
H 6 VC industry experience positively moderates the relationship between the startup characteristics and the funding decision	Rejected
H 7 The VC fund maturity negatively moderates the relationship between the startup characteristics and the funding decision ⁷	Rejected

6. Discussion

The quality of the entrepreneur was found to be more important than all other factors to the VC decision. Such finding is in line with the majority of the previous studies. The first of these studies and perhaps the most cited is the one by MacMillian et al. (1985), who stated that 'above all other criteria, it is the entrepreneur's quality that ultimately determines the investment decision'. However, not all aspects of quality are of the same importance to the venture capitalist investing in Egyptian tech startups. Venture capitalists invested in startups whose entrepreneurs were experienced and had a track record in the industry. This finding was also documented by Shepherd (1999), Franke et al. (2008) and Flynn (1991). The present study showed that neither commitment nor diversity of the entrepreneurial team were found to be statistically significant in shaping the funding decision. In addition, investors seemed to take less into their account the type of education of the entrepreneurial team.

The diversity in the entrepreneurial teams' background/education was not found to be of sizeable significance. In fact, a large number of the startups that got funded had teams with the

⁷ The VC fund maturity acted as an independent variable rather than a moderating variable. All interaction effects with the model's main independent variables (criteria) have insignificant coefficients. The absence of moderation was the basis for rejecting the hypothesis.

same background and some had only one entrepreneur. In previous studies, production/process, marketing/sales and financial/accounting capabilities of the team did not rank as high as other aspects of the entrepreneurial team (Tyebjee & Bruno, 1984; MacMillan et al., 1985; Mishra et al., 2017). A plausible explanation is that various business functions could now be outsourced to professionals who work independently from the startup. With the growth of networks connecting entrepreneurs and the spread of freelancing, functions such as advertising and marketing campaigns could be easily commissioned at a relatively low cost. Alternatively, as the startup grows, entrepreneurial teams could hire employees to carry out marketing, product design and finance but without making them partners.

In line with findings of Zhang (2007), the size of the social network of the startup was found to be important in shaping VC decisions. Entrepreneurs of funded startups had a higher level of engagement in local and international startup events and competitions. Such events give a positive signal on the quality of startup and bring entrepreneurs in contact with a wide network of potential investors, business partners and support entities including accelerators and incubators. These events also get considerable media coverage which can greatly help entrepreneurs in accessing funds.

The study also revealed that startups whose products were fully developed and then tested in the market had higher chances of getting funded than startups with prototypes or partially developed products. With a ready or commercialized product, uncertainty is decreased and the informational gaps are reduced and venture capitalists have a preliminary idea on what the business is worth. This finding is in line with Amit et al. (1998) and Gupta and Sapienza (1992). In more developed VC markets, however, the abundance of capital might be used more readily to back promising business ideas. The scarcity of funds in the Egyptian VC market may cause investors to be more careful with their money that they choose startups already showing some level of success with their products. While this does not spur innovations by allowing ambitious entrepreneurs to experiment and err with their ideas, it helps to weed out unsuccessful endeavors quickly. VCs were not particularly keen to invest in startups that are similar to others that had succeeded in other parts of the region. Investors fund startups with unique products/services as well as those resembling past successes. While a previously proven business model may reduce the failure risks to investors, a working product may mitigate such risks.

In contrast to previous research, market-related characteristics were not as important as the other factors. This finding could be caused by a mismatch between a startup's identified market and the actual market it serves or the inaccuracy of the reported growth rates. To assume that market growth is unimportant will be highly illogical, therefore alternative market characteristics should be tested. The literature presents other reasons that could explain this finding. The flow of VC funds is sometimes slow to react to changes in the market (Gompers et al., 2008). Alternatively, VC activity may increase in slow growing markets that are on the verge of change. Competent investors identify opportunities in untapped markets (low growth) that no one expects to be profitable or can see that an industry is transforming and invest their money and time in it.

The study also shows that startups that have endured the earlier stages of development and are generating positive cash flows have higher chances of getting funded by venture capitalists. This finding is similar to that of Gompers (1997) and Dimov et al. (2007) who concluded that VC prefer investment in companies at the revenue generation stage as investment risk is greatly reduced. Although entrepreneurs communicate financial projections to investors through business plans to show the potential of their startups, it helps a great deal when the financial projections are

based on real financial performance. While early projections cannot be very accurate, they serve as a quality signal that the startup's product is successful and is a proof that a customer base is already forming. Hence knowing the financial aspects can positively affect the VC evaluation of a startup potential investment. Unfortunately, technology-based startups normally incur huge upfront running and developmental costs, which means that early financial strains may decrease the chances of getting funded by VC, ultimately jeopardizing the startups' survival.

The presence of a prior investor did not affect the funding decision of the venture capitalist. A number of reasons may account for this finding. The early investors operating in Egypt may still lack the level of experience and accomplishment that would send a quality signal about the startups they are backing. Alternatively venture capitalists may not be willing to share their returns with others or fear getting tangled in contracts involving prior investors.

The study also reveals that the fund maturity is very important in determining whether a startup will be selected. VCs closed the majority of their deals during the first two years after capital had been pooled into the VC fund. After that, startups' chances drop dramatically. The effect of fund maturity is pronounced because of the limited number of funds raised. Upon approaching the maturity of a fund, venture capitalists are more likely to make follow-on investments in their portfolio rather than enter into new investments. On the other hand, the industry experience of a venture capitalist did not affect the funding decision in a significant manner. While seemingly odd, the VC market is still underdeveloped and most investors in our sample did not have experience in the industry of the startups they invested in. The irrelevance of industry experience was probably mitigated by the formation of syndicates and investing in mature products as well as revenue-generating companies.

7. Capturing the interactions between Criteria

To capture the interactions between criteria, we model VC decisions using decision trees. Decision trees are very interpretable and create very good explanations of the data in the form of if-then-else decisions as well as allow visualization of the data (Hastie et al., 2009). They also rank features (characteristics) according to their importance in affecting the outcome, in this case the investment decision. Decision trees can also capture interactions (non-linear relationships) between features as the tree splits differently on different inputs. Linear regression and logistic regression models fail in situations where the relationship between features and output is nonlinear or where features interact with each other. To draw the tree structure, IBM SPSS model was used. All 200 records were fed into the model for training, with the following configuration: max tree depth=5, minimum records to split a parent node: 20 (10% of data) and the minimum records in a child node: 10 (5% of data).

The root of the tree contains all 200 observations in the dataset. As shown in Figure 2, the most important factor in determining whether a VC will finance a new startup is time into the VC fund, and is used as the first decision rule to split the data. Time into the VC fund was previously tested as a moderator variable, however, the decision tree confirms the results of LR in that the time at which startups apply to the VC fund is of fundamental importance. From the illustration of the decision tree, 125 startups had time into the fund > 2.5 years⁸, 112 were rejected (89.6%) and only 13 startups were accepted (10.4%). Node 2 is said to be a pure node because it provided a decision rule that split the data into roughly 90%-10% groups. This ratio means that we are 90%

⁸ Mean of the variable 'time into VC fund' calculated by the decision tree algorithm.

confident that startups which apply after 2.5 years into the fund will be rejected. Out of a total of 136 rejected startups, this represents a rejection rate of 82.4% based on fund maturity alone. Along the path time into the fund > 2.5 years, the tree further splits the data based on product stage.⁹ The number of startups with undeveloped product were 94 startups. Only 3 startups (3%) were funded and 91 startups (97%) were rejected. This leads to a high degree of confidence in the rejection of startups that have undeveloped product given that they applied more than 2.5 years into the VC fund.

Alternatively, out of 75 startups with time into the fund ≤ 2.5 years, 24 startups (32%) were rejected and 51 startups (68%) were accepted. Node 1 is less pure and another split is made. A decision rule based on industry experience is applied to the data (75 startups). Node 3 shows that out of 31 startups with no industry experience, 17 startups (54.8%) were rejected and 14 (45.2%) were accepted. Industry experience along this path resulted in a 50%-50% split of the data and the node is said to be very impure. The tree applies a decision rule based on product stage. Along the same path $\text{IndExp} = 0$ (a total of 31 startups), for product stage = 1 or 2, all 12 startups were rejected (100%). For product stage = 3 (a total of 19 startups), 5 startups (26.3%) were rejected and 14 startups (73.7%) are accepted. Along the path $\text{IndExp} = 1$ (a total of 44 startups), 7 startups (16%) were rejected and 37 startups (84%) were accepted (node 4). The tree then applied a decision rule based on revenues. Along the same path $\text{IndExp} = 1$, the number of startups with no revenues was 12 startups, of which 5 startups (42%) were rejected and 7 startups (58%) were accepted.

For revenue = 1 (32 startups), 2 startups (6%) were rejected and 30 startups (94%) were accepted. Node 10 is a highly pure node. When the number of startups become small, further splits will cause over-fitting and the applied decision rules will be particular to specific cases and cannot be generalized to other datasets.

As can be observed in Figure 3, the decision tree ranked the decision rules learnt from the data, according to their importance and improvement contributed to the whole model, as follows: 1- time into the VC fund, 2- product stage, 3- industry experience and 4- revenues. Another important advantage of the decision tree is capturing interactions between decision rules. For example if time into fund ≤ 2.5 years the entrepreneur has experience but no revenues, the chances to get funded drops from 15% (30/200) to 3.5% (7/200). If the entrepreneur does not have experience and the product is still being developed, the chances to get funded is almost nonexistent even if he or she applied within 2.5 years from the start of the VC fund. Startups applying after this window have a higher chance to get funded if their products are commercialized.

⁹ 'Product stage' is an ordinal variable alternative to the dichotomous 'ready product' where 1= prototype, 2=untested but viable product and 3=commercialized product. The split by the decision tree indicates similar results to the LR analysis.

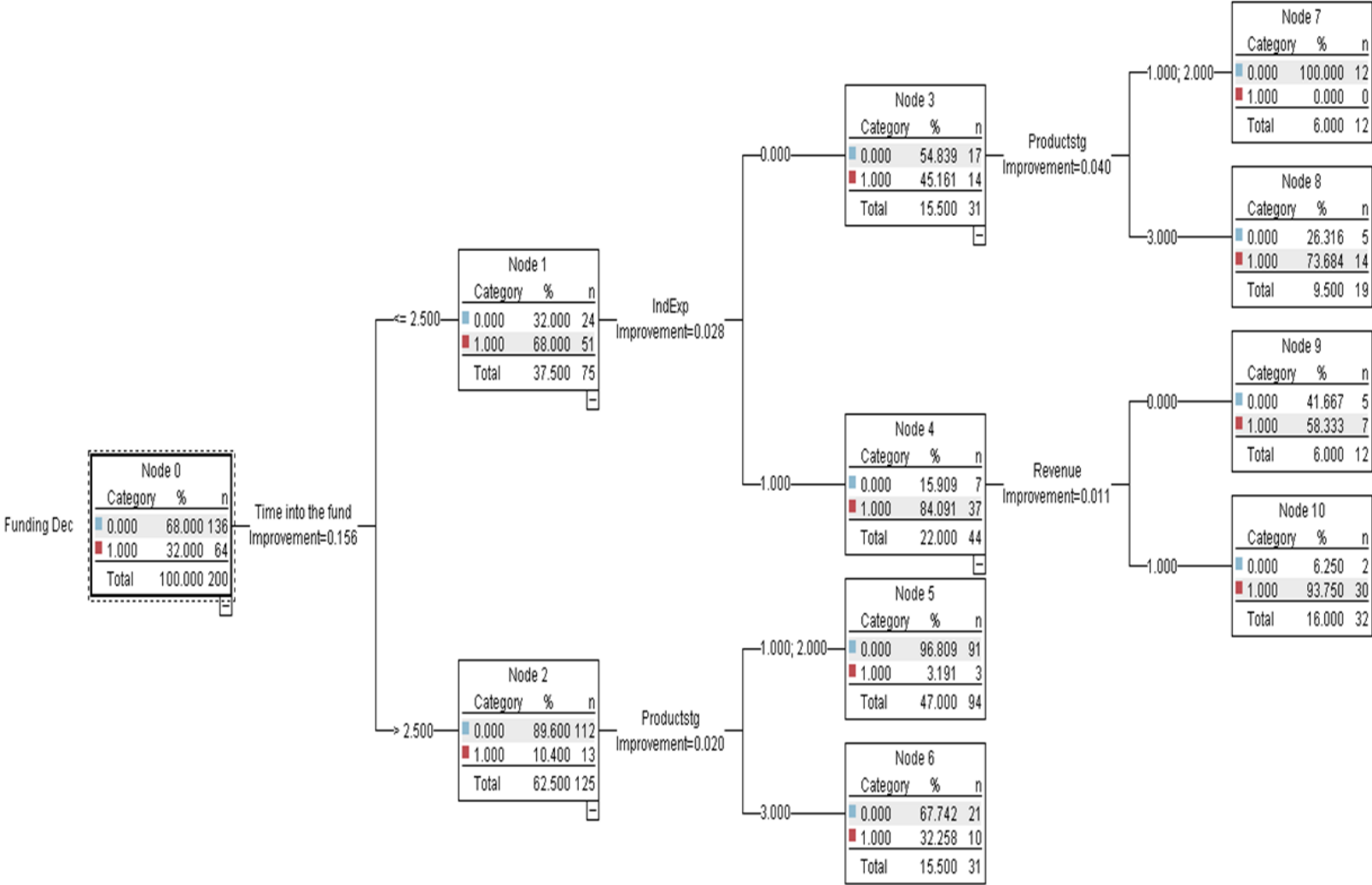


Figure 2 Illustration of VC decision rules using decision tree

Modeling the data using decision trees provided useful insights into how the independent variables may interact together. Results showed that a higher rejection rate was attributed to startups' applying later into the VC fund than there was acceptance for those applying earlier. By applying later, about 90% of startups were rejected in contrast, a startup applying in the first few years was twice as likely to get funded, depending on its other characteristics. Because VCs seem to make deals in the first years of the fund, the time into the VC fund, serves as the gateway for further evaluation. This shows that the limited capital available for investment is a huge constraint to the startup ecosystem. Next in importance is the product stage followed by industry experience. Specifically, undeveloped products were often reason to reject a startup. However, not possessing industry experience was not enough reason for rejection. A startup could still be considered for funding, provided its product was fully developed. This reflects that, for a VC, a ready product preceded experience. The faster products are brought to market, the faster a startup generates revenue thus reducing the risk of investment to the VC. Unquestionably, the absence of industry knowledge combined with an underdeveloped product guarantees that a startup will be rejected. The availability of financial information about the startup were considered next in importance. Startups that generated positive revenues, given they were not rejected for the previous three criteria, have 35% higher chances to get funded. The availability of financial information means that VCs can evaluate a startup more accurately.

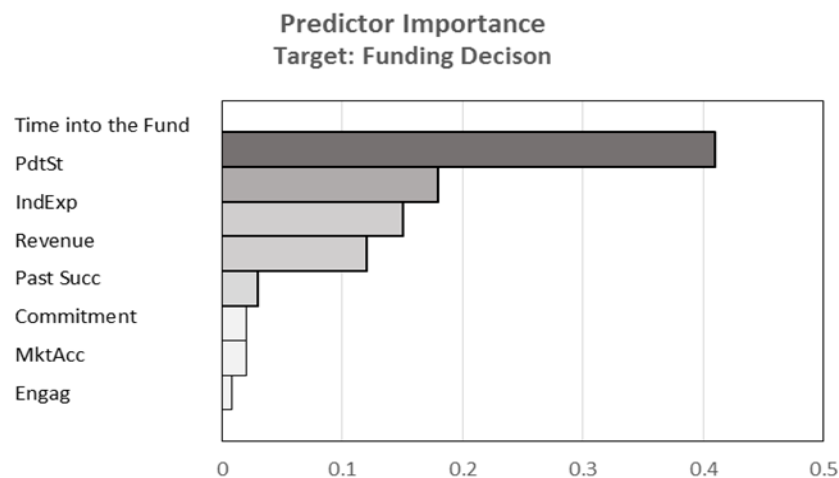


Figure 3 Ranking of decision criteria according to decision tree analysis

8. Conclusion

The study shows that the decision to fund a new startup is mainly shaped by the entrepreneur's industry experience, product stage, revenues, time of applying to the VC fund, and the size of the entrepreneur's social network. Using decision trees to map VC decisions reveal that the time of application to the VC fund serves as a gateway for further evaluation. Although interwoven together, the stage of the product precedes the entrepreneur's industry experience and the availability of financial information in importance. Similar to the time of application, the product stage is an important factor in startup rejection.

The study has important practical implications for entrepreneurs. Developing the product and bringing it to market as fast as possible should be their first concern. Entrepreneurs should

also work on cultivating business connections and engage in local and international startup events to gain traction for their startups. Unfortunately, deciding when to apply is critical and the chances of getting funded are greatly constrained by the limited number of VC funds. In a relatively young ecosystem like the Egyptian venture capital market, VC-related characteristics are bound to play an important role in shaping final funding outcomes. Venture capitalists, being focused on actual performance metrics, tend to choose attractive startups with low business and market risk. While the present study builds on and adds to previous work on VC investment criteria, the inability to access deal-related data and other ‘sensitive’ financial information, such as VC returns and startup valuations, restricted the number of variables under study. The use of such information can further enrich our understanding of VC decision making and therefore may be an important venue for future research.

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