The utilization of hybrid approaches to classify venture capital decisions and predicting the ruling factors that influencing their granting fund to Egyptian start-up and SMEs.

استخدام الأساليب الهجينة لتصنيف قرارات رأس المال المخاطر والتنبؤ بالعوامل الحاكمة التي تؤثر على منحها التمويل للشركات الناشئة المصرية والشركات الصغيرة والمتوسطة.

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Abstract

This study aims to improve the classification accuracy of venture capital granting decisions to startups and SMEs in Egypt, predict the ruling factors that affect granting financing to those companies, and present a decision-making model that can be used as critical standards for venture capital granting decisions to startups and SMEs. To achieve these goals, we conducted a questionnaire survey that targeted 28 Egyptian venture capital firms' investment committees which have 224 members. Hybrid methods were used such as discriminant analysis that was combined with both factor analysis and median partitioning to examine the various factors (12 factors) that represent determinants of risk capital grant decisions based on the results of previous studies. The results showed that the legal environment, the economic environment, The business model, type of sector, location, company size, net revenue, stage of growth funded by the venture capital fund, and finally years of experience respectively have all played a role in influencing decisions to grant venture capital to startups and SMEs in Egypt. The results of the comparison of the hybrid methods used in the statistical analysis also showed that the discriminant analysis model integrated with median partition achieved the highest classification accuracy with a value of 97.2%, while the discriminant analysis model with factor analysis achieved a classification accuracy of 84.4%.

Keywords: Venture capital granting decisions, start-ups and SMEs, discriminant analysis, factor analysis, and medoid partitioning.

الملخص:

تهدف هذه الدراسة إلى تحسين دقة تصنيف قرارات منح رأس المال المخاطر للشركات الناشئة والصغيرة والمتوسطة في مصر، والتنبؤ بالعوامل الحاكمة التي تؤثر على منحها التمويل لتلك الشركات، وتقديم نموذج لصنع القرار يمكن استخدامه كمعيار حاسم لقرارات منح رأس مال المخاطر لتلك الشركات، ولتحقيق هذه الأهداف تم استخدام استبيانًا استهدف ٢٨ لجنة استثمارية تابعة لشركات رأس المال المخاطر في مصر، والتي تضم ٢٢٤ عضوًا، كما تم استخدام الأساليب الهجينة، مثل التحليل التمييزي الذي تم دمجه مع كل من التحليل العاملي والتقسيم المتوسط لفحص العوامل المختلفة (١٢ عنصرا) التي تمثل محددات لقرارات منح رأس المال المخاطر بناءً على نتائج الدراسات السابقة، وقد أظهرت النتائج أن البيئة القانونية، والبيئة الاقتصادية، ونموذج الأعمال، ونوع القطاع، والموقع، وحجم الشركة، وصافي الإيرادات، ومرحلة النمو التي يمولها صندوق رأس المال المخاطر، وأخيرًا سنوات الخبرة على التوالي قد لعبت جميعها دورًا في التأثير على قرارات منح رأس المال المخاطر للشركات الناشئة والصغيرة والمتوسطة في مصر، كما أظهرت نتائج المقارنة للأساليب الهجينة المستخدمة في التحليل الإحصائي أن نموذج التحليل التمييزي المدمج مع التقسيم المتوسط حقق أعلى دقة تصنيف بقيمة قدرها ٩٧,٢٪، في حين حقق نموذج التحليل التمييزي عن طريق التحليل العاملي على دقة تصنيف ٨٤,٤ %.

الكلمات المفتاحية: قرارات منح رأس المال المخاطر، الشركات الناشئة والمؤسسات الصغيرة والمتوسطة، التحليل التمييزي، التحليل العاملي والتقسيم المتوسط.

Introduction

Venture capital (VC) is a type of non-bank funding that is common in developed financial markets for small and start-up(Freear, Sohl, & Wetzel, 2002). Also, Venture capital finance is used to fund the start-up and SMEs of a business or the development of an industrial or commercial project, that have high risk and return(Verma, Shome, & Patel, 2021).

The first venture capital fund was born and has succeeded in the United States in 1946. The US VC industry has grown substantially. As a result, a significant portion of today's successful American technology companies received venture capital during their early stages. The list includes Microsoft, Cisco Systems, Apple Computer etc. (P Gompers & Lerner, 1999). in addition, (Groh, Liechtenstein, & Lieser, 2011) analysis the economic effect of venture capital-backed enterprises, as reported by the US NVCA, he found that venture capital-backed firms employed over 12 million people and produced almost $3 trillion in sales in 2008. Private sector employment represents 21% of the US GDP that year. Additionally, venture-backed firms have an incentive to grow faster and generate more employment than their non-VC counterparts. Furthermore, (Ojonta & Research, 2023) represent that a large majority of successful startups have been backed by venture capital firms across different geographical contexts. There are thousands of businesses seeking capital, as well as top-tier VC firms from around the world.

(Grilli, Latifi, & Mrkajic, 2019) analyzed the growth of sales and employees of 500 start-ups localized in Germany and the UK. They found that VC-backed firms specialize in selecting the most promising ventures and provide value-added services to the firms they invest in. These findings confirmed with the results of (Biney, 2018) who found statistically significant impact on annual sales and employment of venture-backed SMEs at 1.5 percent and 3.7 percent respectively.

According to MENA region, Egypt in MENA Venture Investment report (MAGNITT, 2019) mention that Egypt was ranked as the first in terms of the number of startups investment deals among the Middle East and North Africa (MENA) region countries in 2019. Furthermore, Egypt accounted for 25% of the total deals and becoming the fastest-growing startup ecosystem in the Middle East and North Africa. Moreover, there are 3-8 million micro-

enterprises and 67,000 small firms in 2020 with $4.9 billion in the capital. Some of these SMEs began to experiment with internet enterprises (Central Agency for Public Mobilization and Statistics CAPMAS, 2022).

Startups and SMEs in Egypt are addressing gaps in the market, solving local problems, and ensuring entrepreneurship. Despite the many challenges that hinder the growth of startups in this emerging market, innovation, and enthusiasm within this growing startup ecosystem remain rife. Consequently, it is particularly important to pay attention to this type of financing that contributes to its development and increasing the number of projects and achieving economic and social development. In addition, venture capital indirectly fulfils Social Goals because it produces jobs and balanced regional development because of the successful new firm establishment.

The purpose of this study is using differentiation analysis (DA), factor analysis (FA), and cluster analysis (CA) to study the factors affecting the acceptance of venture capital firms to grant funding to SMEs. As a result, the following are the study's objectives**:**

1. Classifying and distinguishing the factors affecting granting venture capital the fund to startups and SMEs in Egypt.
2. predict the ruling factors that affect granting venture capital the fund to startups and SMEs in Egypt.

The remainder of the paper is organized as follows: **Part II** Literature review about the factors that affect the accessibility of venture capital funding to start-ups and SMEs**. Part III** the important of this study and the methodology. Part **IV** the result dissection, finally the conclusion and suggestions recommendations**.**

Part II Literature review

Many Researchers have been interested in venture capital as a unique form of funding. for example, (Yearbook & Venture Capital Association, 2012) defines venture capital as professional equity that is co-invested with the entrepreneur to support an early stage (seed and start-up) or growth company. To compensate for the high risk, the investor anticipates a larger-than-average return on his or her investment. Typically, venture capital is invested in tiny businesses with extraordinary growth potential or in businesses that have

expanded rapidly and are ready to continue growing. Feld & Mendelson,(2019) refers to venture capital as a financial investment in a high-risk business with the goal of generating a high rate of return**.**

Some studies have dealt with the effect of venture capital companies on the performance of emerging, small, and medium companies. Some of them had a negative effect, such as(Bottazzi & Da Rin, 2002). VC-funded companies do not generate more sales or employment than companies that are not backed by VC. Some of them did not have a significant effect. (Astrid & Bruno, 2004)proved that there is no significant effect of VC on sales growth and employment growth, while many studies showed a positive effect of venture capital, such as (Audretsch & Lehmann, 2004), who showed that employment growth is higher in VC-backed firms. (Bertoni, Colombo, & Grilli, 2013)found strong evidence that VC investments positively impact firm growth. Also, (Nyanamba, Memba, Muturi, Maswari, & Management, 2017)represents that the economic impact of venture capital has been realized by SMEs in terms of sales growth, profit, asset management, and improvement in the management of finance and other resources. The social impact from venture capital perspective includes the employment opportunities created which have improved people's lives and alleviated poverty among the employees. Biney, (2018) showed that SMEs which receive VC financing experience better performance regarding to sales and employment growth.

Many researchers discuss the empirical variables that affect the accessibility of venture capital funding to start-ups and SMEs. This section discusses the results of empirical literature on the venture capital financing of startups and SMEs as follows**:**

First -   Factors related to the characteristics of startups and SMEs.

2/1 Sectors: (the industry in which SMEs works)

(Quaye, Abrokwah, Sarbah, Osei, & Management, 2014) found that the role of VC appears clearly in financing small and medium-sized companies that have a financing gap, especially in sectors deprived of government financing, because SMEs have high risks and do not have sufficient guarantees. These results are consistent with the findings of the(Biney, 2018)'s study.

2/2 Location

(Sorenson & Stuart, 2001) and (Ahmed & Hamid, 2011) show that SMEs situated near venture capital companies have a greater chance of acquiring venture finance. In Addition, CO (Biney, 2018)found that SMEs situated in urban regions had a greater chance of securing financing than firms located in rural areas**.**

2/3 Net Revenues

(P Gompers & Lerner, 1999) and (Dimov, Shepherd, & Sutcliffe, 2007) explained that venture capitalists prefer to invest in businesses during the revenue-generating stage since the investment risk is significantly decreased. Also, (Ismail & Medhat, 2019) proved that firms with positive cash flows have a greater likelihood of being financed by venture capitalists.

2/4 Business Model

(Kaplan & Lerner, 2010) propose a "jockey vs. horse" approach for examining which elements are more stable throughout the course of a successful venture capital investment. The entrepreneurial team represents the "rider," while the strategy and business model represent the "horse". They studied if venture capitalists place a higher premium on the jockey or the horse when making investment selections. They found that venture capital investments are made in the early phases of a firm's lifecycle, while the business model's trustworthiness is still being established**.**

(P. A. Gompers, Gornall, Kaplan, & Strebulaev, 2020) studied 681 different venture capital companies and discovered that VCs prioritized the management team (or jockey) when making investments. The management team was most recognized as a significant element (by 95% of venture capital companies) and as the most essential component (by 47 percent of the VCs). However, business model (or horse)-related elements were also commonly stated as significant, with 83 percent citing the business model, and 37% of organizations ranked business-related considerations as most essential**.**

2/5 Team Diversity

(Kim, Chatterjee, & Higgins, 2018)found that discovered a correlation between past entrepreneurial experience and the likelihood of obtaining

external financial resources. (Baum & Silverman, 2004) and (Hsu, 2007) discovered that team's management abilities and team diversity improve both the chance of acquiring venture capital and the likelihood of receiving it via both direct and indirect relationships to venture capitalists.

2/6 Working Experiences

(Biney, 2018),(Kim et al., 2018), and (Borgia & Newman, 2012) represent that there is a correlation between entrepreneurs' experience and their ability to acquire venture capital investment. (P. A. Gompers et al., 2020) and (Hsu, 2007) found that experienced entrepreneurs have far more access to capital than rookie entrepreneurs.

2/7 Technology

(Hellmann & Puri, 2000) and (Kaplan & Lerner, 2010) proved that venture capital promotes creativity, research, and development. In addition, (Paul Gompers, Kaplan, & Mukharlyamov, 2016)found that venture capital focuses on sectors with a high level of technological competence.

2/8 Education Level

(Aryeetey, 1994) found that owner's education level is positively and significantly correlated with the probability of accessing credit. (Ahmed & Hamid, 2011) firms with a manager who holds a bachelor's or post-graduate degree have a higher probability of accessing credit than firms with non-graduate managers. (Ojonta & Research, 2023) discovered that a positive relationship between owner/manager personal traits and business performance of SMEs. He suggested that financing factors for firms are owner characteristics, company characteristics, and ownership work experience, and educational background that drive the success of SMEs .

2/9 fund stage

(Shane & Stuart, 2002), (Nyanamba et al., 2017)and CO (Biney, 2018) proved that venture capital investments are made during the early stage of a company's lifecycle (seed and start-up), when the viability of its business model is still being established. or growth ventures.

2/10 Firm Size

(Akoten, Sawada, Otsuka, & change, 2006) represent that There is positive correlation between firm size and access to venture capital funding. Additionally, (Biney, 2018) found that firm size has been regarded as a crucial factor of financial accessibility. smaller businesses may have greater development potential but may also have more restricted access to external financing **.**

Part III Second: Factors of legal and economic environment:

2/11 legal environment

(Groh et al., 2011)found that global VC and PE (privet equity) institutions shift their activities from "traditional countries towards emerging regions after the financial crisis 2008. Emerging countries attract investors by exceptional growth opportunities that require substantial funding. This is in addition to the availability of a suitable legal and economic environment for investment. Da (Da Rin, Hege, Llobet, & Walz, 2006) investigates the relationship between venture investments and the Legal Environment in thirty-nine countries, he found that countries with a better legal tradition will provide more governance and value-added services because better laws facilitate faster deal screening and origination which lead to facilitate board representation of the investors. In addition, (Adongo, 2012) studied the political and legal determinants of cross-country differences in venture capital (VC) investments. The results show strong and positive effects of this factor on the inception and development of VC investment activity. Therefore, the governments and institutions should pay attention to legal systems and legislation, which leads to entrepreneurship and innovation benefit significantly from an active VC industry**.**

2/12 economic environment

(Cherif, Gazdar, & Economics, 2011)Found that market capitalization, GDP growth, R&D expenditures, and unemployment are the most macroeconomic determinants of European Venture Capital investments. Early- stage investments and funds raised are different, which are affected by institutional quality. While the economic freedom index has a significant and positive effect on funds raised, it does not appear to be a significant determinant in early-stage

investments. (Bernstein et al., 2015)represent that information about human assets is causally important for the funding of early-stage firms, and hence, for entrepreneurial success. (Grilli et al., 2019) investigated institutional dimensions such as regulatory policies, indicators of government quality, financial markets and other contextual determinants that significantly affect VC investment activity **.**

In Egyptian market, many researchers investigated the factors which are conducive to VC activity such as (Turki, 2015) who explained that VC Programs in Egypt are either Incubators or VC funds. The difference between them is that incubators will provide seed funding and angel investments, while VC funds will invest only in Existing and Established firms that have the potential to grow. he suggested that Public Venture Capital Programs should provide funding to all SME's no matter what stage they are because there should be numeric goals for next 5 years in terms the amount of money to be invested in VC deals, number of companies funded, locations of the investments, sectors that need investments and growth. In addition, (Ismail & Medhat, 2019) illustrations that the VC decision of grant fund to a new start-up is 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. Correspondingly, (Abdel Samee Ahmed, 2022) indicated that VCs prioritize team diversity, net revenue, and technology have a significant effect on venture capital decisions. It is worth noting that previous studies used regression analysis as a tool to evaluate their hypotheses.

3/1- The important of this study:

According to the results of previous studies, which illustrate the global interest of studying the factors that affect the venture capital decisions to fund startups and SMEs. whether internal factors related to the characteristics of the companies requesting financing or external factors related to legal and economic environment factors. However, in Egyptian market there have been limited studies about the environmental factors that support VC activity. Consequently, the purpose of this study is covering this gap, through an investigation of the Egyptian legal and economic environment factors in addition the characteristics of startups and SMEs that affect VC activity by using two methods of integration known as hybrid approaches instead of

using regression analysis, which previous studies used.

Hybrid approaches used to classify venture capitalist granting decisions for startups and SMEs in Egypt. Furthermore, predict the ruling factors that affect granting venture capital to startups and SMEs. These represent the main objectives of this study, which differ from the objectives of previous studies in the Egyptian market.

The expected findings of this study will aid VC decision-makers in improving their policies and strategies and making the right decision in granting fund to startups and SMEs In addition, this study will help the formal institutions to develop the legal and economic environment to promote venture capital who interested in joining the Egypt market.

The hypotheses:

The following is the formulation of the study hypotheses in the form of the null hypothesis:

1- hybrid approaches (the discriminant function equation via factor analysis and the discriminant function equation via medoid partitioning) are not significant and unable to classify the venture   capital financing decision to Startups, SMEs companies.

2.hybrid approaches are not able to predict the ruling factors that affect granting venture capital financing to Startups, SMEs companies.

3-The results of the discriminant function analysis via factor analysis and the discriminant function analysis via medoid partitioning are not differ significantly.

4-There is no statistically significant effect of legal and economic environment on the acceptance venture capital to grant fund to Startups, SMEs companies.

5-There is no statistically significant effect of startup or SME characteristics on the acceptance of venture capital to grant them funds.

3/3 Research Methodology

The purpose of this study is to obtain an estimated classification function based on some statistical measures by using two methods of integration known as hybrid approaches, which lead to improved classification accuracy and Discrimination efficiency between the venture capitalist granting decisions

forstartups and SMEs in Egypt and predict the ruling factors that affect grantingventure capital financing to these companies. The first approach integrates factor analysis with discriminant analysis, and the second, medoid partitioning with discriminant analysis. Cronbach's alpha will be used for reliability testingwithin each variable.

3/4-Research Design

To achieve the study's goal, questionnaires used to collect primary data from Egyptian venture capitalists until the end of 2022. The study population consisted of all 28 Egyptian venture capital firms and their investment committees; there are 224 members of those committees. We received 178 responses, more than the sample size required, and Data from venture capital online platforms such as Magnitt, Tracxn, Crunchbase.

3/5- Description of the variables, the symbols, and Descriptive statistics

Table 3 shows that the Economic environment X_{12} has the highest mean value of 4.23 with a small standard deviation value of 0.92 at a maximum of 7.17 and a minimum of 1.55 when compared to all variables; however, Table 1 shows that the Sector X_1 has the smallest mean value of 0.16 with a small standard deviation value of.24 when compared to all independent variables.

Table 1 Description of the variables, and the symbols

Variables	Symbol	Type
Venture capitalist granting decisions	Y	Qualitative (Dummy)
Sector	X_1	Quantitative
Location	X_2	Quantitative
Net Revenue	X_3	Quantitative
Business Model	X_4	Quantitative
Technology	X_5	Quantitative
Team Diversity	X_6	Quantitative
Working Experiences	X_7	Quantitative
Educational Level	X_8	Quantitative
VC Fund Stage	X_9	Quantitative
Firm Size	X_{10}	Quantitative

Variables	Symbol	Type
Legal environment	X_{11}	Quantitative
Economic environment	X_{12}	Quantitative

Table 2 Descriptive statistics

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Y	178	0	1	0.75	0.44
X_1	178	0	1	0.16	0.24
X_2	178	0	1	0.17	0.12
X_3	178	0	1	0.31	0.28
X_4	178	0	1	0.22	0.26
X_5	178	0	1	0.86	0.35
X_6	178	1	3	1.29	0.61
X_7	178	0	1	0.58	0.26
X_8	178	1	4	2.22	0.47
X_9	178	0	1	0.4	0.24
X_{10}	178	0	1	0.39	0.23

Table 3 Descriptive statistics

Variables	N	Minimum	Maximum	Mean	Std. Deviation
X_{11}	178	-1.68	3.73	1.23	1
X_{12}	178	1.55	7.17	4.23	0.92

Where: that the legal environment X_{11} is average of sub factors including laws and legislation, governance rules application, and tax laws and exemptions.

 the economic environment X_{12}, which includes the large size of the market, the stability and regularity of market rules, and the availability of transparency.

3/6-Reliability test for questionnaire items:

The following results obtained using Likert scale variables and Cronbach's Alpha:

Table 4 Cronbach's alpha coefficient to check the stability of all questions.

Reliability Statistics	
Cronbach's Alpha	N of Items
.837	12

The Cronbach's coefficient value in Table 4 clearly shows that the study tool is extremely stable. All the survey questions totaled 0.837.

Cronbach's alpha for all variables (factors) ranged from 0.810 to 0.826, which is good because it is greater than 80%. This indicates that the tool is stable, and its results can be relied on.

Internal Consistency: The validity of the variables in the current study was evaluated to determine how well a test addresses different constructs, provides reliable scores, and the validity of the tool used in the study was proven.

3/7-Normality Test

The preceding table shows that the level of significance of the Kolmogorov-Smirnova test statistic for all study variables is greater than 0.05, indicating that the study data has a normal distribution.

Table 5 Test of Normality

Kolmogorov-Smirnova test			
Variables	Statistic	df	Sig.
X_1	0.052	178	.200*
Y	0.05	178	.200*
X_2	0.05	178	.200*
X_3	0.04	178	.200*
X_4	0.038	178	.200*

Kolmogorov-Smirnova test			
Variables	Statistic	df	Sig.
X_5	0.054	178	.200*
X_6	0.057	178	.200*
X_7	0.048	178	.200*
X_8	0.04	178	.200*
X_9	0.047	178	.200*
X_{10}	0.046	178	.200*
X_{11}	.034	178	.200*
X_{12}	.048	178	.200*

Part IV the result dissection

Factor analysis (FA) results

Variables granting venture capital financing to Egyptian start-ups and SMEs were determined using factor analysis. and reduce these variables into low components. The new components from factor analysis will then be used as inputs (new independent variables) in discriminant analysis to improve the classification accuracy of granting venture capital financing to Egyptian start-ups and SMEs(Hasan, Abdulazeez, & Mining, 2021).

Variables from X_1 to X_{12} have submitted for factor analysis We obtained the following results using the SPSS 27 program.

The preceding Tables show the tests performed prior to using the principal components method.

Multicollinearity problem

Since the value of the determinant of the correlation matrix, which equals 0.0004542, is greater than 0.0001, as shown in Table 6, there is no issue with multicollinearity between the study variables, and the factor analysis can conduct without removing any of the study variables.

Table 6 Test of multicollinearity problem, the sample's adequacy, and the significance of the correlation matrix.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.839
Bartlett's Test of Sphericity	Approx. Chi-Square	2514.433
	df	66
	Sig.	0.00
The determinant of the correlation matrix value		0.0004542

First, from Table 6 the value of the Kaisers-Meyer-Olkin (KMO) measure of sampling adequacy score equals 0.839, which is greater than the recommended level of 0.50. This means that the sample is adequate to conduct factor analysis. Second, the Bartless test of sphericity is significant (Chi Square with significant probability value <0.00), indicating that there are sufficient inter-correlations between the variables to allow factor analysis to be used.

Communalities are the proportion of each variable's variance that can explained by the factors as shown in Table 7. For instance, the extracted value of the Sector X_1 variable is 0.810 indicates that the common factors explain 81% of the variances in the variable's values. Finding out the values of communities indicates that the common factors explain a good portion of the differences.

Table 7 Results of factor analysis via the principal component method (PC)

Variables	Communalities	Rotated Component Matrix	
		Components	
		PC_1	PC_2
X_1	0.810	0.897	
X_2	0.573	0.756	
X_3	0.887	0.924	
X_4	0.911	0.939	
X_5	0.333		-0.577
X_6	0.328		0.428
X_7	0.823	0.819	
X_8	0.023		0.884

Variables	Communalities	Rotated Component Matrix	
		Components	
		PC_1	PC_2
X_9	0.914	0.906	
X_{10}	0.934	0.948	
X_{11}	0.843	0.819	
X_{12}	0.905	0.841	

Rotated Component Matrix

To achieve the axes orthogonal, the researchers used the Varimax method. This matrix indicates the variables' loadings on the components, and the values in the matrix indicate how closely each variable is correlated with each Component Eight out of the ten variables have strong relationships with the first component, according to Table 7. We find that two Components extracted.

The first component includes the following eight variables: Sector (X_1), Location (X_2), Net Revenue (X_3), Business Model (X_4), Working Experiences (X_7), VC fund Stage (X_9), Firm Size (X_{10}), Legal environment (X_{11}), Economic environment (X_{12}).

The second component includes the following variables Technology (X_5), Team Diversity (X_6) and Educational Level (X_8).

Table 8 displays the proportion of the total variance that explained, the total variance's detailed explanation, and the process for determining the components using the principal components method.

Table 8 the proportion of the total variance

Total Variance Explained			
Components		% of Variance	Cumulative %
	Initial Eigenvalues		
PC1	6.767	56.388	56.388
PC2	1.519	12.656	69.044

The study's variables reduced from ten to two principal components by using the PC method, and according to SPSS 27, the eigenvalues of the two principals explained 56.388% and 12.656% of the variance, respectively.

The two components' eigenvalues are greater than one, as shown in Table 8. We found out that the total variance that the first and second components together explain is 69.044%, and thus the proposed components can used because they are greater than 60%.

Based on the previous results, the factor analysis model equations via the PC method of factors that affect venture capitalist granting decisions for Egyptian startups and SMEs can presented as follows:

$$PC_1 = 0.897X_1 + 0.756X_2 + 0.924X_3 + 0.939X_4 + 0.819\,X_7 + 0.906X_9 +$$

$$0.948\,X_{10} + 0.819X_{11} + 0.841X_{12} \quad (1)$$

$$PC_2 = -0.577\,X_5 + 0.428X_6 + 0.884\,X_8 \quad (2)$$

Medoid Partitioning Algorithms (MP) results

In this study, the Medoid partitioning Algorithms was used to partition data on venture capitalist granting decisions for startups and SMEs into clusters with similar and dissimilar objects, and the class labels that results from Medoid partitioning will be used as a dependent variable in discriminant analysis to improve the classification accuracy of granting venture capital financing to Egyptian start-ups and SMEs. Here, Spath's algorithm determines the appropriate number of clusters by using random starting cluster configurations and silhouette statistics(Chouhan & Chauhan, 2014).

Table 9 is used to determine the optimal number of clusters. The number chosen represents the maximum value of (Average Silhouette). Typically, the selected row will have a respectable Adjusted Average Distance (this value should be near its minimum). The average silhouette per cluster ranges from (-1: +1).

Table 9 Iteration Summary Section

Number of Clusters	Average Distance	Adjusted Average Distance	Average Silhouette
2	7432.20	83.51	0.71
3	4532.94	76.40	0.66
4	3625.77	81.48	0.65

Table 9 shows that the two clusters have the highest average silhouette value (0.71). Because an average silhouette value of 0.71 to 1.00 indicates the discovery of A strong structure has been found ("excellent" clustering solution), and with good average distance and adjusted average distance, the analysis will be conducted using two clusters based on NCSS 12 outcomes.

Table 10 Cluster Medoids Section

	Cluster1	Cluster2
	Granting financing	Not granting financing
Rows	160	18

The row number of each cluster's medoid is given in table 10's report. The new independent variable resulting from Medoid Partitioning will be used as input (independent variable) in discriminant analysis.

The results of discriminant analysis via factor analysis (DA-FA) and via Medoid Partitioning (DA-MP)

The independent variables are entered sequentially in stepwise discriminant analysis based on their ability to discriminate between groups(Stella & Practice, 2019).

The Box's Test of Equality of Covariance Matrices was used in the study's Model 1 and Model 2 to check the assumption of homogeneity of covariance across groups using a significant level less than.001 as a criterion. Box's M (248.844, 76.622) was not significant, p (0.655, 0.515) > (.001), indicating that there are no significant differences between the covariance matrices. As a

result, the assumption is not violated, and Wilk's Lambda is an appropriate test to use.

Table 11 explains how discriminant analysis is integrating with factor analysis and medoid partitioning in what are known as hybrid approaches,(Stella & Practice, 2019).

Hybrid approaches improve classification accuracy and discrimination between venture capitalist granting decisions for startups and SMEs in Egypt, as well as predict the ruling factors influencing their grant of venture capital financing.

While Model 1 uses components obtained from factor analysis as independent variables, Model 2 uses class labels obtained from Medoid partitioning as a dependent variable, and DA is utilized to perform subspace selection.

Table 11 Summary of Canonical Discriminant Functions Model 1 (DA-FA)

	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
Model 1 (DA-FA)	1.025	100	100	0.711
Model 2 (DA-MP)	46.243	100	100	0.989
	Function	1		
	Sig.	0.00		

Based on the eigenvalue in Table 11, the second model is superior because the greater the eigenvalue indicates the more variance in the dependent variable is explained by this function.

The values of canonical correlation were 0.711 and 0.989, respectively, for the two models, which indicates the strength of the relationship between the derived function and the groups of the dependent variable. The discrimination function explained 100% of the variance in the dependent variable, demonstrating its effectiveness in classifying venture capitalist granting decisions for Egyptian startups and SMEs.

Table 12 indicates the importance of the discriminatory function in separating groups using Wilks' Lambda and the goodness Chi- square test. The Wilkes statistic in Model 1 and Model 2 is (0.494, 0.021), which is close to zero, so the function in both models has a high discrimination power. However, the value of Wilkes lambda was lower in the second model, indicating that it is superior. The chi-square statistic has a significance level of less than 0.05 in both models, the function can distinguish and separate the two groups in the study.

Table 12 The importance of the discriminatory function

Wilks' Lambda				
Models	Wilks' Lambda	Chi-square	df	Sig.
Model 1 (DA-FA)	0.494	123.461	2	0
Model 2 (DA-MP)	0.021	655.4	12	0

Test the significance of the factors affecting the discriminant model.

Table 13 and 14 test the significance of Influencing factors in the Discrimination model, determining the contribution of each independent variable to the classification process.

Table 13 summarizes the outcomes of Model 1.

Tests of Equality of Group Means				
	Independent Variables	Wilks' Lambda	F	Sig.
Model 1	PC_1	0.51	170.61	0.00
	PC_2	0.99	2.48	0.12

Table 14 summarizes the outcomes of Model 2.

Tests of Equality of Group Means				
	Independent Variables	Wilks' Lambda	F	Sig.
Model 2	X_1	0.48	190	0.00
	X_2	0.56	138.6	0.00

Tests of Equality of Group Means			
Independent Variables	Wilks' Lambda	F	Sig.
X_3	0.62	106.67	0.00
X_4	0.28	454.9	0.00
X_5	0.98	3.71	0.06
X_6	0.99	1.52	0.22
X_7	0.85	31.5	0.00
X_8	1	0.49	0.49
X_9	0.7	74.12	0.00
X_{10}	0.58	126.51	0.00
X_{11}	0.07	2547. 6	0.00
X_{12}	0.13	1193.9	0.00

The Wilks' lambda in Table 13 and 14 is a measure of how well each function separates cases into groups; smaller values of the Wilks' lambda indicate that the function has greater discriminatory ability. The more important independent variables that contribute significantly to the prediction by the discriminant function, as indicated by the smaller values of Wilks's lambda, are PC_1 in model 1, which has a relative importance value of 1.

In model 2, legal environment (X_{11}) has the highest relative importance, implying that it contributes more to the process of predicting the dependent variable, followed by economic environment(X_{12}), business model (X_4), sector (X_1), location (X_2), firm size (X_{10}), net revenue (X_3), VC fund Stage (X_9), finally working experiences (X_7).

Table 15 shows that in model 1, the first component (PC_1) includes, the following nine variables: (X_1), (X_2), (X_3), (X_4), (X_7), (X_9), (X_{10}), (X_{11}) and (X_{12}) are the component that have a significant effect on the dependent variable and would include in model 2. Accordingly, these variables can discriminate and separate the two groups of venture capitalists granting decisions for Egyptian startups and SMEs, and these variables had the highest F-statistic and the lowest Wilks' lambda statistics.

Table 15 Unstandardized Canonical Discriminant Function Coefficients

		Function1
Model 1	PC_1	1.399
	(Constant)	0
Model 2	X_1	3.66
	X_2	14.87
	X_3	-1.11
	X_4	0.76
	X_7	-6.41
	X_9	-1.69
	X_{10}	6.02
	X_{11}	11.14
	X_{12}	7.22
	(Constant)	-76.16

Estimating the discriminant model

Table 15 indicates the Unstandardized Canonical Discriminant Function coefficients. They are used to construct the actual prediction equation, which can be used to classify new cases. In both models, the equations are as follows:

$$\widehat{Y}_{Model\ 1} = 1.399PC_1 \ (3)$$

$$\widehat{Y}_{Model\ 2} = -76.16 + 3.66(X_1) + 14.87(X_2) - 1.11(X_3) + 0.76(X_4) - 6.41(X_7) - 1.69(X_9) + 6.02\ (X_{10}) + 11.14(X_{11}) + 7.22\ (X_{12}) \ (4)$$

Classification Statistics

Table 16 and 17 indicate that the Discriminant function via factor analysis and via Medoid Partitioning successfully classified 84.8% and 97.2% of original cases, respectively.

Table 16 Classification Results of Model 1

Model 1 (Discriminant analysis via factor analysis)			
Original classification	Predicted Group Membership		
	Granting financing%	Not granting financing %	Total
Granting financing	81(81.8%)	18 (18.2%)	99(100%)
Not granting financing	9(11.4%)	70 (88.6%)	79 (100%)
84.8% of original grouped cases correctly classified.			

Table 17 Classification Results of Model 2

Model 2 (Discriminant analysis via Medoid Partitioning)			
Original classification	Predicted Group Membership		
	Granting financing%	Not granting financing %	Total
Granting financing	144 (97.3%)	4(2.7%)	148(100)
Not granting financing	1 (3.3%)	29(96.7%)	30(100)
97.2% of original grouped cases correctly classified.			

Given that the discriminant analysis was applied to the same data and the classification accuracy was 77.5%, it indicates that integrating the discriminant analysis with each of the factor analysis and medoid partitioning yields better results in the classification of venture capitalist granting decisions for Egyptian startups and SMEs, with preference for the results of the discriminant analysis via Medoid division. As shown in Table 18 and 19, the linear discriminant function is evaluated based on the Group Centroids.

Table 18 Functions at Group Centroids

Model 1	
Y	Function 1
Granting financing	-.899
Not granting financing	1.127

Table 19 Functions at Group Centroids

Model 2	
Y	Function 1
Granting financing	-1.072
Not granting financing	5.290

In the current study, the standardized coefficient for classification is maintained by the average of the group centroid, According to the previous tables, the average for the not granting financing decision group was (1.127, 5.290) in models 1 and 2, respectively, which means that by compensation in the discrimination equation, granting decisions are classified as not granting financing if the value is positive, but granting decisions are classified as Granting Financing if the value is negative.

Conclusion

This study aims to improve the classification accuracy of venture capitalist granting decisions to startups and SMEs in Egypt, predict the ruling factors that affect granting venture capital financing to these companies, and present a decision-making model that can be used as critical standards for venture capitalist granting decisions to startups and SMEs through an efficient hybrid approaches based on integrating discriminant analysis with factor analysis (mentioned here as Model 1) and discriminant analysis with medoid partitioning (mentioned here as Model 2).

The results of the study showed that the first null hypothesis was rejected and the alternative hypothesis was accepted, because the results found that Integrating between algorithms improves the classification accuracy as we take advantage of the potential of each algorithm; hence, venture capitalist granting decisions to startups and SMEs are classified by discriminant analysis into several homogeneous groups (granting financing, not granting financing) using components extracted from factor analysis in model 1 and class labels extracted from medoid partitioning in model 2. Therefore, it is possible to reach a reliable model that will help the decision-makers to make the right decision in granting venture capital or not to startups and SMEs and clarify the factors affecting the acceptance of grants for these startups and SMEs to use them in improving their performance to obtain financing. The analysis results also show that the discriminant function successfully classified 84.4 and

97.2% of the original cases, respectively, via factor analysis and Medoid partitioning.

According to the analysis results, the two models (the discriminant function analysis via factor analysis and the discriminant function analysis via medoid partitioning) as well as predicting the factors that influence venture capitalists grant decisions for Egyptian startups and SMEs. Hence, these results represent that the second null hypothesis was rejected, and the alternative hypothesis was accepted, which states that the hybrid approaches can predict the ruling factors that affect granting venture capital financing to Startups, SMEs companies.

Furthermore, the two models (the discriminant function analysis via factor analysis and the discriminant function analysis via medoid partitioning) do not differ significantly. the two models contained the same variables, confirming the significance and importance of these variables in discriminating between the two groups of venture capitalists granting decisions for Egyptian startups and SMEs. This proves the validity of the third null hypothesis and rejects the alternative hypothesis.

According to the analysis results, the critical factors that influence the classification of capitalist granting decisions to startups and SMEs in Egypt and predict the ruling factors that affect granting venture capital financing for these companies were the legal environment, followed by the economic environment, business model, sector, location, firm size, net revenue, VC fund stage, and finally working experiences, respectively. This proves the fourth and fifth null hypothesis were rejected, and the alternative hypothesis were accepted.

Based on the results of this study, the proposed recommendations are as follows:

1- the government and formal institutions should pay attention to legal environment and legislation which representing in stability of laws and legislation, applying governance rules and Tax laws which leads to entrepreneurship and innovation benefit significantly from an active VC industry. Specially, the results demonstrated that the legal environment is considered the most important factors that influencing granting financing to startups and SMEs in Egypt.

2- It is also important to develop and improve the economic environment including the stability and regularity of market rules and the availability of

transparency. Specially, the results showed that it is the second importance after the legal environment in its impact on granting venture capital financing to startups and SMEs in Egypt.

3- startups and SMEs Companies should benefit from the results of this study in developing their characteristics and considering their arrangement of the priorities that will attract and encourage venture capital companies to grant them the required financing.

4- 4-The recommendations of suggested future research are analyzing the role of informal institutions towards the development of VC in emerging countries. Specifically, the role of social capital has been particularly neglected and needs to be paid attention to in future research. In addition, other hybrid approaches should be considered because they have proven to be effective.

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