

<https://doi.org/10.33472/AFJBS.6.Si2.2024.3165-3174>



African Journal of Biological Sciences

Journal homepage: <http://www.afjbs.com>



Research Paper

Open Access

A NOVEL CSW-DEA-RA-ML ANALYSIS OF ACCESS TO INSTITUTIONAL CREDIT TO MICRO, SMALL AND MEDIUM ENTERPRISES: CHALLENGES AND SOLUTIONS

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Volume 6, Issue Si2, 2024

Received: 19 March 2024

Accepted: 20 April 2024

Published: 10 May 2024

[doi:10.33472/AFJBS.6.Si2.2024.3165-3174](https://doi.org/10.33472/AFJBS.6.Si2.2024.3165-3174)

1. ABSTRACT

Access to credit, especially institutional credit serves as a fundamental catalyst for fostering entrepreneurship development and driving economic growth within any nation. For micro, small, and medium enterprises (MSMEs), timely access to finance is imperative for their sustenance and growth. This paper aims to delve into the multifaceted challenges encountered by MSMEs in accessing finance and how the role of technology emerges as a potential game-changer in reshaping the financial landscape for MSMEs, offering innovative solutions to enhance their access to crucial financial resources. The paper will be focused on finding the factors that significantly affect the availability of credit and how that affects the performance of MSMEs. For this purpose, a novel hybrid technique that combines Data Envelopment Analytics (DEA), that uses Common Set of Weights (CSW) with Regression Analysis (RA) and Machine Learning (ML) will be used to assess the viability of the model.

Keywords: MSME, Finance, Fintech, Technology, Data Envelopment Analytics (DEA), Machine Learning (ML)

1. INTRODUCTION

Micro-, small-, and medium-sized enterprises (MSMEs) constitute the predominant share of businesses, especially in developing nations [29]. They play a pivotal role in fostering job creation and contributing significantly to global economic development. These enterprises constitute approximately 90% of all businesses and contribute to nearly two-thirds of the global job market [10].

India has always been a hub of cottage and household industries for ages. From the first five-year plan (1951-56) to the seventh five-year plan in the year 1987-1992, the government of India continued its efforts to promote this sector. It was 2006 when the MSME Act was laid down defining the criteria of segregating industries as Micro, Small, and Medium. Based on investment in plant and machinery the enterprises can be classified as Micro (25 Lakhs), Small (above 25 Lakhs to 5 Crore),

and Medium (Above 5 Crore to 10 Crore) [15]. MSME has contributed significantly to the economic and social development of the country by fostering entrepreneurship and generating large employment opportunities. They have been complementary to large industries and have contributed towards the inclusive development of the nation [23][35]. However, the limited access to investment and working capital financing serves as an impediment to the growth of these industries [35]. Small firms consistently report more financing needs than medium-sized and large firms. It is also observed that traditional lending institutions often deny business loans to MSMEs due to a dearth of essential track records, suitable collateral, and credit history [10]. According to a report by IFC in 2018, MSME faces a credit gap as high as 25 lakh crores, which otherwise can be met by financial institutions easily [17]. The question now arises is what factors affect access to credit flow to MSME?

There is a lot of work on financial inclusion and digital finance. An open, inclusive, and responsible digital financial ecosystem was one of the main themes of G20 2023 [16]. The advanced technologies like Artificial Intelligence (AI), big data analytics and blockchain have the potential to transform the lending process [18]. This poses another question; how does the application of advanced technologies, such as blockchain, artificial intelligence, etc, aid in solving the financing challenges of MSMEs and do we have a sound regulatory framework that can safeguard against cyber threats and mitigate insecurities?

The paper is aimed to address the above questions in which the author will study the major factors that influence and hinder the flow of credit to MSME and its relation with the performance of MSME. There will also be exploratory research on how new-age technologies address the issue of credit flow to MSMEs.

2. WHAT AFFECTS THE FLOW OF CREDIT?

2.1. Identifying the factors influencing the sustainability and growth of MSMEs

A study conducted by the United States Agency for International Development (USAID) in 2019 has tabulated the level of impact of different types of interventions. Limited access to finance for investment and innovations is one of the most serious obstacles to MSME growth and is one of the most important determinants of firm performance [31].

Claessens & Laeven, (2005) [6] **Error! Reference source not found.** argue that industries that are naturally heavy users of external finance grow faster in countries with more competitive banking systems. Beck, A, & V, (2005) [5] show that financial development weakens the impact of various barriers to firm growth and that small firms benefit the most from financial development. Ayyagari, Demiguer-kunt, & Maksimov, (2011) [3] examined the impact of various factors on firm growth across 80 countries. The outcome identified finance and political settings or policy frameworks to have a more direct impact on firm growth.

The studies conducted and theoretical concepts developed by various scholars identify many factors influencing the sustainability and growth of MSMEs. These factors can be broadly outlined as external and internal factors [14].

External factors are the factors that are beyond the control of the enterprise including demographic factors like preference, beliefs, and temperaments, social factors like human relationships, cultural factors, political factors, and financial factors. Internal factors include factors like the capacity of the entrepreneur to grow, risk-taking ability, innovation, and internal management factors.

2.2. Source of Finance

There are majorly two sources of MSME finance, namely, institutional and non-institutional. Non-institutional includes loans from money lenders, friends, and relatives. This is characterized by high rate of interest. Institutional sources, on the other hand, include all those that are regulated by the Reserve Bank of India like the Scheduled Commercial Banks (Public Sector Banks, Private Sector Banks, Small Finance Banks, Foreign Banks, Co-operative Banks, Regional Rural Banks) and the Non-Banking Financial Institutions (NBFC). Additionally, Angel Investors, Venture Capitalist, and Private Equity are also the institutional sources and these are governed by the Securities Exchange Board of India (SEBI) [24].

Fig 2: RBI Statement: Deployment of Gross Bank Credit by Major Sectors

(Rs. Crore)					
Sr.No.	Sector	Data			Variation (Financial Year)
		30.Jul,2021	25.Mar,2022	29.Jul,2022	29.Jul,2022 / 30.Jul,2021
					%
I	Gross Bank Credit (II + III)	10800511	11891314	12369224	14.5
5.2	Micro & Small Enterprises	1209760	1377138	1441472	19.2
	Medium	160312	213996	219327	36.8
	MSME Sector	1370072	1591134	1660798	21.2
Note: 1. Data are provisional and relate to select banks which cover about 90 per cent of total non-food credit extended by all scheduled commercial banks.					
5. Micro & small enterprises under item 5.2 includes credit to micro & small enterprises in manufacturing as well as services sector.					

Source: https://www.rbi.org.in/Scripts/BS_PressReleaseDisplay.aspx?prid=54289, Dated :- 30.08.2022

2.3. Difficulties in obtaining credit

Every business whether it is small-sized or large-sized predominantly relies on commercial banks as a primary source of funding. However, research has shown that in obtaining financial credit from institutional sources MSME faces larger difficulties and restrictions as compared to large-size businesses, due to them being riskier investments [26]. Fatoki & Asah, (2011) [11] discovered that firm type is an important parameter in obtaining debt from commercial banks, with small-size businesses facing more trouble compared to large-size businesses. It is also noted that obtaining credit and loans from non-institutional sources like friends, family, and money lenders is far more approachable and more frequent than the formal sources [33]. As per the 4th census of MSME, only 5.18% of the registered as well as unregistered enterprises received funding from institutional sources, 2.05% were obtaining

(Rs. Crore)					
Sr.No.	Sector	Data			Variation (Financial Year)
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funding from non-institutional sources, and the remaining 92.07% were either self-financed or had no source of funding [24]. As per the recent data (Fig 2) the total credit available to MSME, as displayed

on the MSME Dashboard, 13.4% out of the gross bank credit was availed by the MSME sector in March and Jul 2022 individually.

Another reason why MSMEs do not approach institutional sources is the cost of obtaining credit and the difficult process of obtaining credit. A large number of MSMEs do not depend on bank credit due to lack of timely credit, information asymmetry, issue of collateral, and procedural delays. Therefore, there is a need for alternative sources of finance [4].

For the research, the author has narrowed the factors that affect the flow of credit to MSME as follows:

- Internal Factors: the author will be using the Size of the enterprise, age of the enterprise, and ownership pattern as internal factors that affect the flow of credit to MSME.
- External Factors: Government Policy, Institutional lending practices, and the location of an enterprise as external factors affecting the flow of credit.

3. MEASURES TAKEN TO IMPROVE CREDIT FLOW TO MSME

As per the latest press release by the Government of India on PIB Delhi in December 2023 [21]:

- 3.1. It is mandated that any loan up to Rs. 10 Lakh will not warrant any collateral security. To further the flow of credit, the Credit Guarantee Scheme for Micro and Small Enterprises enables a hassle-free loan disbursement up to Rs 5 crore.
- 3.2. The PM Mudra Yojna is providing loans to non-farm and non-corporate small and micro enterprises and the limit has been set up to Rs. 10 Lakh.
- 3.3. All bank loans to MSMEs that follow the prescribed criteria and conditions are to be treated under priority sector lending. Even retail and wholesale traders can enjoy the benefits of Priority Sector Lending.
- 3.4. Trade Receivables Discounting System (TReDS) platform facilitate the financing of trade receivables from corporate and other buyers including Government and Public Sector Banks through multiple financiers electronically. MSMEs can now get an attractive rate of discounting their bills through a transparent electronic auction mechanism. At present, there are three platforms that offer financing under the TReDS framework. Though it is successful there remain almost 60 million MSMEs outside of the formal credit system. This can be improved if the TReDS system onboards more private corporates and PSU buyers on its platform [17].
- 3.5. Emergency Credit Line Guarantee Scheme up to Rs 5 Lakh Crore to businesses including MSME.
- 3.6. Launch of Udyam Assist Platform to bring Informal Micro Enterprises under the formal ambit of MSME so that they can avail the benefits of Priority Sector Lending.
- 3.7. Equity infusion of Rs. 50,000 crores under the Self-Reliant India Fund, to provide equity funding in those MSMEs that have the potential to grow and become large firms [22].

4. ANALYSING THE SCOPE OF NEW-AGE TECHNOLOGIES IN FINANCE

One of the solutions to bridge the gap between financial institutions and MSMEs is via new-age technologies that can help address the majority of the issues. Businesses are adopting digitisation in their processes, and with this, the operation of small businesses becomes more transparent creating an environment of trust between the lender and the borrower. Artificial Intelligence (AI) and data analytics can reduce the burden of following a cumbersome process of paperwork and credit risk assessment and will promote lending based on cash flow [2].

One of the ongoing benefits of using digital technology in the world of finance is the use of digital KYC, where the authenticity of the borrower can be addressed through an online verification process. Even the tax records of the borrower can be accessed online. All of this makes it easy for the financing institutions to lend as well as for small businesses to borrow. All in all, the key is to find

innovative working capital financing solutions [1] like blockchain that can help a seamless integration of facilities like TReDS exchanges reducing the risks like financing the same bill repeatedly [17].

4.1. FinTechs and Big Techs

As per the Bank of International Settlements (BIS), a bank that acts as the central bank of the world, fintech and big tech are the new upcoming alternatives to the traditional banking system. Easy access to internet and mobile technology and low cost of computing and data storage, makes it easy for analysts and researchers to get hold of the big data that can help improve credit analysis, process efficiency, risk management, product design, customer service and other areas [12].

The entire loan application process is also costly and cumbersome. Digital innovations can help in cutting the cost of collecting, processing, and storing of data. This can make it easy for the borrower to find and secure a suitable offer of a loan or find a desirable investment plan. Account Aggregators (AA), a new category of companies created by the Reserve Bank of India will facilitate a link between borrowers and the fintechs or lenders. The aggregator will collect information about the borrower from the banks and mutual funds, and share it with fintechs, banks, and other financial companies to assess their creditworthiness and determine the potential of the borrowers. The information is encrypted for the aggregators and can only be accessed by financial institutions [19].

Blockchain is a step further, it makes the parties (lender and borrower) interact on a peer-to-peer basis even when they do not know each other beforehand. That is no need for an intermediary like a bank to assess credit or provide a continuous monitoring and servicing function [13].

More fintech means more information, greater transparency, improved risk assessment, and reduced need for collateral against loans, credit can even be provided to businesses with low or limited credit history which is also a step towards financial inclusion. Since it is the technology and AI, customised and tailored investment and loan services for the customers can be expected [7]**Error! Reference source not found.**

4.2. Open Credit Enabling Network (OCEN)

OCEN is a democratised system that enables any business entity to become a loan service provider. It is a set of standard Application Programming Interfaces (APIs), in which any loan service provider and account aggregator can connect with potential borrowers. For instance, if Ola plugs into the OCEN system then its drivers can avail loans from any loan service provider that onboards the Ola app through OCEN. This system was developed by an Indian think tank software company iSPIRIT and was first announced in July 2020. The first app to onboard the OCEN system was GeM SAHAY which connected vendors to apply for working capital loans [17].

4.3. Risks and threats

The entirety of the digital world, however, is not risk-free. Peer-to-peer (P2P) lending was initiated in China which reached its growth in 2017 post which the system started cracking and finally, it culminated in 2019. Another recent event of failure of Wirecard in Germany provides lessons that systematic regulation and supervision of fintechs and big techs is pre-dominant. When the world is dependent on AI and the internet for financing needs cyber threats and privacy threats become another major risk. Cybersecurity is a risk for traditional as well as innovative fintechs and big techs. Everything will be transparent and there will be little or no privacy, providing tailored services can compromise privacy or become abusive [12].

It is a common belief that fintechs will follow profits. They may provide loans to incumbents that are too big to fail or on the basis of short-term leverage. It is argued that new regulatory frameworks need to be set to address issues particular to fintechs [27].

Digital frameworks like OCEN and AA have expedited the credit disbursement processes but they are facing difficulties in doing digital KYCs of partnerships, private limited, and public companies. There is also a mandate to have a GSTIN to avail loans on these apps which makes it difficult for the small businesses to avail noncollateralised loans [17].

5. METHODOLOGY & RESULTS

The paper uses a novel hybrid technique that combines Data Envelopment Analytics (DEA) with Regression Analysis (RA) and Machine Learning (ML). DEA is a popular non-parametric technique that measures and enhances the efficiency and performance of individual Decision-Making Units (DMU). For this it uses dynamic weights that allows DEA to be price-free. However, it suffers from a drawback, these weights may not be optimal. Thus, to remedy this the author is using an estimated Common Set of Weights (CSW) that will provide a common basis for comparison.

Data is collected from a total of 500 firms from two districts of the state of Himachal Pradesh. First, the efficiency scores have been computed using the CSW-DEA method. The DEA will be output oriented that is DEA maximises output for given inputs. Second, RA is applied on the data. Third, the data is trained using ML techniques. The trained model will be predicted on the test set. For ML analysis Random Forest (RF) method of ML will be used. It will show the importance of the variables to predict the model.

The RA will be divided into two parts, first, the internal factors will be taken as the independent variable and dependent variables will be taken as Sales turnover and Profitability. Second, the external factors will be taken as independent variables and dependent variables will be taken as Sales turnover and Profitability (Table 1). For the first part, Truncated regression model will be used and for the second part, Probit regression will be applied. The Truncated model will

For the ML analysis, Random Forest is used. It will denote the importance of individual variables and how frequently they are used to predict the model. Out of 500 data samples 400 will be used for training and 100 will be used for testing.

Table 1: Factors affecting the Flow of Credit to MSME

Internal Factors	External Factors
Size of the Firm	Government Policy
Age of the Firm	Institutional Lending Practices
Ownership Pattern	

5.1. First Stage: The use of CSW-DEA-RA

For the internal factors it was observed that the CSW-DEA-RA efficiency scores under the assumption of constant returns to scale was 0.814. The efficiency scores indicate that the model is a good fit, approximately 81% of the efficiency is explained by the internal factors.

Table 2: Average Efficiency Score CSW-DEA-RA

	Obs	Mean	SD
CSW-DEA-RA	500	0.814	0.359

5.2. Second Stage: The RA

It was found that Sale and Profit both are (i) negatively influenced by the firm's age and (ii) positively influenced by the ownership of firm and the size of the firm (Table 3).

Note: * significant at 10% level

These findings are consistent with the literature. For instance, it can be argued that young firms are less likely to be awarded with loans [34] that will in turn affect their business process and sales and profitability. Also, firm size can indirectly affect growth, larger firms face significantly lower financial constraints as compared to small and medium [5] affirming that there is a positive relation between size and profit and sale. Ownership is another factor that has a positive relation with the access to finance and legal structure of the firm [11].

Table 3: Predictive performance of different Models

Variables	R Coefficient	R Coefficient
	(Sales)	(Profitability)
Size of the Firm	0.0118 *	0.0064 *
Age of the Firm	-0.0007 *	-0.0003 *
Ownership	0.0592 *	0.0642 *

Table 4 shows the Probit regression of external factors on availability of credit. To assess the role of Government policy four factors were considered. First two are if the enterprise has knowledge of CGTMSE and if they have applied for CGMSE. The Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE) was introduced by the Government of India in 2000. The aim of this policy was to facilitate the availability of bank credit without the hassles of collaterals/third party guarantees to the first-generation entrepreneurs. There is a positive relation with both these factors that is if the enterprise has a knowledge and has availed the benefit of CGTMSE then it becomes easier to avail loan.

The other two are interest rate and collateral have a negative relation with availability of credit. If they are higher the chances of credit reduce.

Institutional lending practices also has a negative relation with credit availability. If the process is difficult then the chances of credit reduce.

Table 4: Probit Regression analysis result

External Criteria	Availability of Credit
Government Policy	
- Knowledge of CGTMSE	-Positive
- Applied for CGTMSE	-Positive
- Interest Rate	-Negative
- Collateral	-Negative
Institutional Lending Practices	
- Lengthy & Complex Procedure	-Negative

Table 5 shows the coefficient value of probit regression. The regression coefficient is highly significant if the enterprise has applied for CGTMSE. It can also be observed that the regression coefficient is negative for collateral, interest rate and lengthy process as was observed in table 4.

Table 5: Probit Regression

Variables	Coefficient (Sales)	Coefficient (Profitability)
Knowledge about the CGTMSE	0.373*	0.473*
Applied for the CGTMSE	0.894**	0.832**
Collateral demanded	-0.394**	-0.410**
Interest rate	-0.474***	-0.523***
Lengthy and complex process	-0.402**	-0.462**

Note: * significant at 10% level, ** significant at 5% level, *** significant at 1% level

5.3. Third Stage: The ML

It was also found from the RF variable importance that out of all the factors application of CGTMSE and Ownership is identified to be the most important factor (variable importance = 0.7723 and 0.6331 respectively), rest of the variables were almost equally used in making the predictions from the data (Table 6).

Table 6: Predictive performance of RF Model

Variables	RF (Variable Importance)
Size of the Firm	0.5231
Age of the Firm	0.4165
Ownership	0.6331
Knowledge about the CGTMSE	0.3891
Applied for the CGTMSE	0.7723
Collateral demanded	0.5584
Interest rate	0.4546
Lengthy and complex process	0.4452

6. CONCLUSION AND WAY FORWARD

MSME is a potential game changer for the economic development of a country. It helps in increasing the production capacity, add employment opportunities and help in bridging the supply and demand gap. The only thing that is hindering its development is the availability of credit. The Government has introduced schemes like TReDS, OCEN, AA and CGTMSE to help remove that barrier. What is left is that enterprises must be made aware of these facilities and more and more financial institutions must join these frameworks. It is also evident that fintechs, Blockchain, Artificial Intelligence will replace the traditional lending system in future, making the entire lending process easy and fast. Machine Learning algorithms will organise and streamline the process and improve efficiency in performance assessment of the businesses. What we require is a safeguarding system that will prevent hacks on privacy of customers and reduce the chances of abuse.

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