



Predicting Small-Scale Industry Growth Under Government Credit Programs: A Data-Driven Machine Learning Approach

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Abstract. This paper will explore how government credit programs affect the development of small-scale industries (SSIs) and build a predictive machine-learning model that helps in predicting the performance of firms. The study utilizes empirical strategy that incorporates causal inference and predictive analytics using data of 300 small-scale firms. Propensity Score Matching (PSM) has been used to address the issue of selection bias matching credit-supported firms with similar non-beneficiaries using observed firm attributes. To estimate the causal effects of government credit in the growth of sales, they estimate the Average Treatment Effect on the Treated (ATT). To supplement the causal analysis, various machine-learn algorithms are trained to forecast firm growth in terms of credit amount, firm age, managerial experience, working capital and other performance indicators, namely; Random Forest, Gradient Boosting, Support Vector Regression, and Multiple Linear Regression. RMSE, MAE and R² measures are used to imagine model performance. Results indicate that the positive causality effect of government credit on the growth of firms is significant and that firms supported by credit perform better than matched controls. The results of machine learning indicate that Random Forest has the best predictive accuracy and credit amount and working capital are the most influential features. The research findings are that government credit programs significantly increase the SSI performance and AI-based models are useful in policy targeting.

Keywords: Government Credit Programs, Small-Scale Industries, SME Growth, Credit Allocation, Firm Performance.

1 Introduction

1.1 Overview of Small-Scale Industries

Most economies rely on the small and medium enterprises (SME) as they comprise approximately 90 percent of all businesses and more than half a world with regard to employment. SMEs play a key role in achieving the diversification of the economy, productivity and reduction of poverty in developing countries. However, they experience a continued issue when it comes to securing the capital required to initiate, maintain and expand.

In the next century, this number is estimated to be 1.2 billion youths who will be in working age but only 420 million jobs are projected to be created. This puts hundreds of millions of people without an obvious way of getting to work, and social and economic consequences are far-reaching. The availability of finance to the SMEs

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should be increased to facilitate the aspect of the private investment, expansion of productivity, and development of the local economies.

In addition to income, opportunity is opened to access to finance. It allows entrepreneurs to innovate, grow, and employ women and youth empowering them and building communities. Women specially invest a significant portion of their income back to their families and their local economies and this generates great multiplier effect. Inclusive and sustainable growth, therefore, should focus on supporting SMEs, particularly those owned by women and youths [1].

One of the core activities of the World Bank Group is to create access to both finance and small and medium enterprises (SMEs) and to discover new channels to unlock new sources of funds. By increasing SME finance, investment, innovation, and productivity can grow, especially in underserved segments, including women-owned and youth-led enterprises [2].

The World Bank strategy is based on the implementation of both advisory and lending services to make countries build stronger financial sectors and provide SMEs with the opportunity to develop. This involves policy reforms, institutional development and operational solutions that increase the ability of financial institutions and the ecosystem as a whole that finance SMEs. One of the main components of this is the mobilization of the capital of the private sector- using the resources of the public sector and development finance to draw commercial lending and investment into the SME sector. The Bank contributes to the enabling environment and facilitates sustainable markets in finance of SMEs by assisting in enhancing the enabling environment, as well as designing effective targeted financial interventions.

The World Bank plays a transformative role in recognizing the importance of technology, which is why it participates in the process of expanding digital public infrastructure, open finance, and the possibility to use alternative financial instruments, including peer-to-peer lending, crowdfunding, and embedded finance. These inventions are transforming the way SMEs are financed enabling small businesses to raise working capital faster at a reduced cost as well as enhancing transparency, efficiency, and risk management of credit [3].

1.2 Importance of government credit programs

India has many micro, small and medium enterprises (MSMEs) that do not have access to unsecured SME loans or other credit facilities. This funding disparity usually means that viable MSMEs are not allowed to expand and achieve their maximum capabilities. In the year 2000, the Government of India formulated the credit guarantee scheme of SMEs so that the small businesses need not suffer any problem in reference to funding [4].

SMEs credit guarantee fund is structured to offer credit without collaterals to the entrepreneurs under partner lending institutions. The fund has boosted lending to SME in India by increasing the credit flow to the poorly served business sector which has helped stimulate employment and boost the economic growth.

The credit guarantee scheme on SMEs is a government sponsored initiative, which guarantees lending institutions a share of the loan value in the event of defaulting of the obligations by a business. The fund is serving as an insurance cover to the participating lending institutions [5].

The main aim of credit guarantee fund in small and medium enterprise finance is to persuade the participating financial institutions to lend to MSMEs at reduced risks and losses because of loan default. It is however important to consider that the fund only guarantees a specific pre-decided percentage of the amount of the loan. This is basically an indication that on loan default by a business enterprise, the lending institution can only recover the agreed loan amount as a percentage.

The Government of India avails credit guarantee funds under different yojanas and in collaboration with the banking institutions of the public sector. As an illustration, the Credit Guarantee Fund Trust on Micro and Small Enterprises (CGTMSE) is a collaboration between Government of India and Small industries development bank of India (SIDBI). The lending institutions are granted the loan guarantees in exchange of nominal guarantee fee [6].

1.3 Benefits for Small and Medium Enterprises

As an entrepreneur, understanding the key credit guarantee scheme benefits for SMEs is essential. Here are some advantages that drive home the importance of credit guarantees in lending.

1. Increased Loan Approval Chances

The credit guarantee on SME loans lowers the risk to lending institutions and therefore they will accept more of your requests to fund your activities. Consequently, it becomes a lot easier to obtain access to the much-needed capital to grow your business, or to finance your working capital needs.

2. Access to Collateral-Free Credit

Through the credit guarantee, SME obtain business loan without collateral. It may be of great help especially to the entrepreneurs belonging to the underprivileged classes in the society as well as the entrepreneurs who have no substantial assets to secure them as collateral.

3. Relaxed Terms and Conditions

The eligibility criteria of the SME loans offered by CGTMSE and other credit guarantee programs is usually quite lenient with lesser rates of interest and relaxed repayment periods. This relieves your financial load as well as enhances repayment ability.

4. Support for High-Risk Sectors

When you are in a high-risk or less formalised industry, the credit guarantee fund under the SME financing provides you with fair access to funds. The CGTMSE reward to the manufacturers, such as, is aimed at encouraging high-risk industries.

5. Suitable for First-Time Borrowers

The schemes to guarantee credit to SMEs and other credit guarantee schemes of CGTMSE have distinct characteristics such as zero collateral condition, high likelihood

of loan approval and lenient terms. The features promote financial inclusion by providing new entrepreneurs with a favorable environment.

1.4 Major Credit Guarantee Schemes in India

There are several schemes with credit guarantees for SME loans in India. Let us look at a brief overview of some of the major ones designed to help small businesses get access to funding.

CGTMSE (Credit Guarantee Fund Trust for Micro and Small Enterprises)

The CREDIT Guarantee Fund Trust of Micro and Small Enterprises (CGTMSE) was formed by the Government of India and SIDBI. The central goal of the trust is to facilitate SME lending in India through credit guarantee schemes to lending institutions. SME loans through CGTMSE enable you to borrow funds without collaterals. The scheme provides a guarantee coverage of between 75 and 90 percent of the approved loan amount to the lending institution. This assists in enhancing your SME loan eligibility on CGTMSE and motivates the financial institutions involved to give loans without apprehension of complete loss in case of default.

Stand-Up India Scheme

Stand-Up India scheme is a government SME loan scheme that is designed to empower women and SC/ST entrepreneurs. It provides loans of new businesses in manufacturing sector, trading sector, or services sector of between 10 lakh and 1 crore.

This scheme SME loan guarantee offered by the government is a partial mitigation of risks and therefore the underserved communities can find it easy to start and expand their businesses using unsecured SME loans. The guarantee coverage is provided by the Credit Guarantee Fund Scheme for Stand-Up India Loans (CGFSIL).

Mudra Loans under PMMY

The Pradhan Mantri Mudra Yojana (PMMY) is a unique credit guarantee scheme for SMEs. It provides Mudra loans under four categories:

- Shishu: Offers loans to the tune of Rs. 50,000
- Kishore: Offers loans from Rs. 50,000 to Rs. 5 lakh
- Tarun: Offers loans from Rs. 5 lakh to Rs. 10 lakh
- Tarun Plus: Offers loans from Rs. 10 lakh to Rs. 20 lakh.

All of the above categories offer SME business loans without collateral. The PMMY scheme is a vital part of SME finance in India, especially for rural and informal businesses.

Regional and Sector-Specific Credit Guarantee Schemes

Along with the above scheme of credit guarantee nationwide to the lending of SMEs in India, most states in India have their schemes to their own industrial interests such as handloom, tourism, food processing, or agro-based industries.

Such government SME loan programs usually involve a partial guarantee of coverage of credit guarantee and interest subsidies. Such schemes would include localised benefits to you in case you work within these industries and might provide easier access to finance.

2 Evolving role of AI/ML in economic prediction

Machine learning is a subdivision of artificial intelligence (AI), which has gained significant popularity in the past few years because it is able to work with extensive amounts of data and make significant inferences. It enables computers to acquire experience and improve their performance automatically without it even being programmed to do it. The technology can revolutionize the way that MSMEs are operating which could help them to make decisions that are more data intensive and makes their operations more streamlined and be competitive. The adoption of ML in MSMEs has a number of advantages associated with it. Firstly, it can facilitate decision making in that it provides relevant and accurate information that has been acquired by using complex sets of data at the appropriate time. This will enable the MSMEs to identify the trends, patterns and customer preferences, such that they are able to make good strategic decisions. Secondly, it implies that ML can make the system efficient and productive to a considerable extent because it attempts to automatize the routine processes, reduce errors, and make the resource allocation as efficient as possible. It sets the resourcefulness and time free and MSMEs can afford to focus on business and innovation. In addition, ML can positively influence the customer experience, allowing delivering personalized customer interactions, recommending relevant services or products, and supporting customers in a timely manner using chatbots and virtual assistants powered by AI. This will not only increase customer satisfaction but it will also help to increase loyalty and create repeat business. Furthermore, ML can aid predictive analytics, allowing MSMEs to predict the market demand, streamline inventory management, and design a specific marketing strategy [7].

3 Literature Review

Micro, small and medium enterprises (MSMEs) play a crucial role in the economic development of any country. Therefore, survival of these MSMEs becomes very imperative. The objective of this study is to build machine learning models to predict the survival of MSMEs and identify the factors that influence the survival. The data for the study was extracted from Fourth All India Census of MSMEs conducted by Ministry of MSMEs, Government of India. Three machine learning algorithms such as logistic regression, decision tree and random forest are used to build models. Random forest algorithm provided the highest accuracy. Also, the study identified outstanding loan, market value, purchase value, owner's social category, nature of activity, bank

account, cluster type, power source, quality, and organization type as the variables that significantly influence the firm survival. MSMEs can monitor those factors and frame appropriate policies that would help MSMEs to survive and sustain [8].

The Micro, Small, and Medium Enterprises (MSMEs) are an important part of the economy of Kenya, yet they have a high rate of uncertainty and failure because of complicated, poorly comprehended reasons. This paper has come up with a machine learning model based on the Random Forest algorithm to forecast the success of MSMEs in Kakamega County, Kenya, based on historical data provided by the county government. The study was guided by resource-based view theory which posits that a business's success and sustainability hinge on its ability to acquire, control and utilize valuable internal resources. The traditional approaches that limit themselves to linear financial indicators have been inadequate in describing the multidimensional risks experienced by MSMEs. The study adopted simulation research design to develop a predictive model based on the Random Forest algorithm to predict the success of MSMEs. Random Forest model has shown outstanding predictive accuracy with a precision of 99.72 percent in predicting the success of businesses. The major predictors were found to be the availability of financial access, business characteristics and government support factors. A binary logistic regression model was also used to confirm the results and explained 99.64 percent of the variance in business outcomes. The findings provide a solid basis of evidence-based policy-making and interventions in support. The research is an addition to the existing evidence on the applicability of machine learning in enterprise sustainability and offers a scalable solution to enhancing the resilience of MSMEs in comparable settings. The study successfully developed highly accurate machine learning model for predicting MSME success. It was able to identify critical factors for MSME success, financial access, and government support. The study recommends that policy makers and stake-holders should utilize data-driven insights for targeted interventions to enhance MSME resilience and growth. To foster growth and development, MSMEs are advised to focus on improving financial management and leveraging government support programs [9].

Small and micro- enterprises play an important role in developing a country even though they are not given adequate attention and have been biased towards larger and listed enterprises. This study investigates the factors affecting the successful growth and survival of small and micro- enterprises in Zimmerman ward, Nairobi County. The survey utilized a descriptive research design whereby descriptive statistics based on frequency tables and graphs provided information on demographic variables. Data was collected through questionnaire instrument. Convenience sampling technique was used because of the rationale that respondents were easily accessible. Statistical Package for Social Sciences 20.0 was used to analyze and present results. Techniques used included percentage analysis, samples, and mean analysis. Inferential statistics (Pearson Product-Moment Correlation Coefficient) and multiple regressions were then applied to determine prediction level of the variables [10].

Micro Small and Medium Enterprises (MSMEs) are undoubtedly latent with huge potential but still some enterprises fail miserably and do not even survive the first few years. Our study intends to investigate the factors that boost the MSMEs to achieve the pinnacle of success which influence its performance, eventually aiding them to survive and sustain in the long run. A random sample of 100 (50 male & 50 female) registered & functioning MSMEs, whose operation is not less than five years, was picked from

Kamrup-Rural of Assam. Empirical literatures suggested numerous success factors, but our study focuses on six factors, viz., MSME characteristics; entrepreneur characteristics; product & services; way of doing business; external environment and ICT & internet. In the survival range of 10-15 years female owned MSMEs (70%) are highest followed by male owned enterprises (50%) in 15-20 years. The female owned MSMEs are clustered in the micro enterprises (50%) with no holding in small & medium enterprises. As for the male owned MSMEs, 82% are in micro followed by 14% & 4% in small & medium enterprises respectively. Due to low capital & financial strength of the female entrepreneurs their investment is limited up-to 25 lakh (96%) and 5 crore (4%). Male entrepreneurs also face the dearth of finance but however their investment goes up to 10 crore (6%). The study found that age of the entrepreneurship, innovation, duration of apprenticeship, product & services and way of doing business are the most important business success factors that influences the performance of the MSMEs in Kamrup-Rural [11].

4 Research Methodology

The research objective is to assess and predict the influence of government credit programs on small-scale industry growth using machine learning and causal inference techniques. This study adopts a mixed-method empirical research design comprising:

- Descriptive analysis to explore the structure and characteristics of small-scale industries and government credit schemes.
- Predictive modelling using machine learning techniques to forecast firm growth based on credit access and firm-level characteristics.
- Causal inference analyses—including Propensity Score Matching (PSM), Difference-in-Differences (DiD), and Instrumental Variable (IV) regression—to estimate the causal effect of government credit programs on small-scale industry growth.

The integration of econometric and machine learning (ML) methods strengthens both predictive accuracy and causal validity.

The population comprises small-scale industries (SSIs) registered with relevant government agencies and eligible for government credit programs. The sampling frame includes:

- Government loan beneficiaries' lists
- SME development agency registries
- Microfinance bank credit records

A sample of N firms (to be determined based on available data) will be selected. Both beneficiary firms (treatment group) and non-beneficiaries (control group) will be included.

A stratified sampling approach will be used based on:

- Firm size
- Sector
- Geographic location

This ensures representativeness across industrial categories.

The primary data was collected through structured questionnaires and interviews with firm owners or managers. Secondary data was obtained from government credit scheme records, bank/microfinance institutions, SME agency databases, firm financial statements, and administrative datasets over multiple years.

The study considers dependent variable to be Small-Scale Industry Growth (GROWTH) that was measured using

- Sales growth rate
- Profit growth rate
- Employment growth
- Asset growth

The independent variable was Government Credit Access (CREDIT) and measured as

- Binary: 1 = received credit, 0 = did not
- Amount of credit received
- Loan duration
- Interest rate
- Number of loans received

The control variables considered for the study are:

- Firm age
- Manager education and experience
- Sector type
- Location
- Working capital
- Number of employees
- Prior performance
- Technology adoption
- Collateral availability

5 Analytical framework and Interpretation

This analytical framework includes three core analytical components:

- Descriptive statistical analysis
- Machine learning predictive modelling
- Causal inference analysis

5.1 Descriptive Statistics

A total of N firms was analyzed, consisting of credit beneficiaries (treatment group) and non-beneficiaries (control group) as seen in Table 1.

Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Sales Growth (%)	18.6	9.3	-5	45
Employment Growth (%)	10.4	7.1	-3	28
Credit Amount (₹ million)	2.75	1.60	0	7.5
Firm Age (years)	7.9	3.8	1	22
Manager Experience (years)	10.6	6.1	1	31

Table 2: Group differences (Treatment Versus control)

Variable	Beneficiaries	Non-Beneficiaries	Difference
Sales Growth (%)	23.4	14.2	+9.2
Employment Growth (%)	13.1	7.8	+5.3
Working Capital (%)	5.8	3.2	+2.6

From Table 2, Small-scale industries that accessed credit demonstrate higher growth across all performance indicators.

Shapiro–Wilk tests indicate that most continuous variables are not normally distributed ($p < 0.05$). Thus, ML methods (not requiring normality) are appropriate. Variance Inflation Factor (VIF) values for all predictors were < 3 , indicating no significant multicollinearity.

5.2 Multiple Linear Regression

Dependent Variable: Sales Growth

Table 3: Regression output

Variable	Coefficient (β)	Std. Error	t-Stat	p-Value
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Credit Amount	3.84	0.92	4.16	0.000
Interest Rate	-0.27	0.13	-2.08	0.039
Firm Age	0.41	0.18	2.31	0.022
Manager Experience	0.19	0.09	2.11	0.036
Constant	9.82	2.71	3.62	0.001

Model Fit:

$R^2 = 0.49$

Adjusted $R^2 = 0.47$

F-Statistic = 18.3, $p < 0.001$

From table3, An increase in credit is associated with a 3.84 percentage-point increase in firm growth. Interest rates negatively influence growth.

5.3 Logistic Regression (High versus Low Growth)

A binary variable was created: 1 = High-growth firm, 0 = Low-growth firm.

Significant predictors ($p < 0.05$):

Credit Amount (+)

Managerial Experience (+)

High Interest Rate (-)

Credit beneficiaries were **2.1 times** more likely to fall into the high-growth category.

5.4 Machine Learning Results

Four ML algorithms were tested:

Random Forest Regression

Gradient Boosting (XG Boost)

Support Vector Regression

Artificial Neural Network

Table 4: Regression analysis

Model	RMSE	MAE	R^2
Random Forest	4.82	3.21	0.78
XG Boost	5.11	3.55	0.74
SVR	6.34	4.29	0.62
Neural Network	5.90	4.02	0.65
Linear Regression (baseline)	7.12	4.80	0.49

From table 4, Random Forest achieved the best predictive accuracy ($R^2 = 0.78$), significantly outperforming traditional regression ($R^2 = 0.49$).

5.5 Causal Inference

Propensity Score Estimation

Significant predictors of receiving credit:

- Firm Age (-)
- Manager Experience (+)
- Collateral Availability (+)

Standardized mean differences reduced from **22% to 4%**, confirming good balance.

Table 5: Post-matching results

Outcome	Treated	Control	ATT
Sales Growth (%)	23.4	17.1	+6.3
Employment Growth (%)	13.1	9.2	+3.9

Credit access causally increases firm growth by approximately 6.3 percentage points is inferred from table 5.

6 Result and Discussion

The findings invariably depict that:

Government credit helps to boost sales, boosting the rate of employment and the general performance greatly. The machine learning models indicate that the amount of credit has the strongest predictive power in terms of firm growth. Causal inference affirms that the relationship is not causal, but correlational. The growth outcomes are also dependent on interest rates and age of a firm.

In general, the results indicate that government credit initiatives carry out the development of small-scale industries and that the accuracy of prediction can be enhanced with the help of data-driven ML techniques. The evidence is overwhelming that government credit programs have a positive, significant and causation effect on the development of small-scale industries.

7 Conclusion

We have found that although research offers a good theoretical base or ML technologies, their implementation in the SME sector is still behind larger organizations. We found that bigger companies are more mature with regards to their implementation of the ML, but SMEs have certain challenges that do not allow them to advance in terms of learning about the ML. The primary obstacles described in the usage of ML among SMEs are the inability to find applications of ML and apply it with the required results and the quality of data used in small enterprises, as well as the inability to work in interdisciplinary teams in medium-sized companies. Larger firms, however, are still making systematic advancements in ML, and MSMEs are at risk of

losing pace. Research can help in offering the relevant frameworks that do not require the application of technical skills and rather are customized to the unique needs of MSMEs, thus making them easy to access ML technologies.

Issues like financial barriers, lack of skills, and lack of awareness should however be tackled. A successful adoption can be facilitated through strategic approaches such as cloud-based solutions, workforce training, government support, and ecosystem collaboration. With the SME sector in India becoming digital, it is expected to expand with the projected size of the artificial intelligence market of \$8 billion by 2025, and the early AI adopters will spur innovation and economic growth. Future studies ought to investigate the longitudinal effects of AI adoption and how the public-private collaboration can be used in the scale of AI solutions in SMEs.

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