

Adaptive Machine Learning Approaches for Analyzing SME Growth and Financial Challenges in Andhra Pradesh

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Abstract:

Role of SMEs in Andhra Pradesh: Small and Medium Enterprises (SMEs) have been key enablers for the development of Andhra Pradesh over the years, driving innovation, generating employment and leading to industrialization. This study explores the relationship between access to financing and SME growth through data science methods and computational approaches. By analyzing a dataset of 200 SMEs, we utilize advanced statistical and machine learning algorithms to uncover insights into financial health, borrowing behaviors, and credit access challenges. A few analytical methods (i.e., descriptive statistics, correlation analysis, and clustering) demonstrate heterogeneous characteristics of funding preference and performance metrics. The results reveal that SMEs display a preference for grants, as opposed to bank loans or self-funding, whereby exorbitant interest rates charged by banks and complicated cross-border regulations have deterred access to traditional funding avenues. Furthermore when doing predictive modeling the factors considered include external market factors such as trade volumes and currency fluctuations as well as internal factors relating to efficiency of operations on SME performance. Computational techniques discussed in the study could aid in creating targeted financial plans for SMEs, such as loan finding algorithms and decision support systems to enhance accessibility and sustainability. The advice in this regard would be to an institutional investor or asset owner to introduce digitalization platforms to support financing, to use AI-powered tools to improve levels of financial literacy, and to automatism regulatory compliance requirements. Policymakers and financial institutions, therefore, can build a strong ecosystem for SME growth, ensuring economic resilience and innovation in the region by adopting data-driven strategies.

Keywords:SME Financing, Financial Performance, Credit Access Challenges, Policy Interventions, Economic Resilience

1. Introduction

Small and medium-sized enterprises (SMEs) are indispensable in driving economic growth, fostering innovation, and generating employment in Andhra Pradesh[1].These enterprises are the backbone of the state economy and contribute significantly to regional development and industrial diversification.However, the ability to thrive and sustain operations relies heavily on access to financial resources[2].Financing is a crucial enabler of SMEs, empowering them to invest in infrastructure, technology, and human capital. It also provides the liquidity required to navigate economic uncertainties and capitalize on market opportunities[3]. Andhra Pradesh's SME landscape encompasses textiles, pharmaceuticals, agriculture, and information technology industries. For

instance, the textile sector is a major contributor to domestic and export markets, with SMEs leading the production of handloom and power loom products. These businesses often require financing to upgrade machinery, expand their production capacity, and access global markets. Similarly, the pharmaceutical industry in Andhra Pradesh is a key player in India's generic drug manufacturing sector, where SMEs are integral to R&D and supply chain operations[4]. Agricultural SMEs, particularly in food processing and value addition, drive rural economic growth, support farmers, and ensure efficient utilization of the state's agricultural resources.

Despite their economic importance, SMEs in Andhra Pradesh face significant barriers to affordable and timely financing[5]. High interest rates, stringent collateral requirements, and complex regulatory frameworks hinder the securing of necessary funds. These challenges force many SMEs to rely on self-financing or informal credit sources, which may limit their growth potential and expose them to higher financial risk. The lack of adequate financing often constrains their ability to invest in innovation, expand operations, and improve productivity, thus creating a critical gap in the state's economic development framework[6]. This study aims to address these gaps by examining the role of financing sources in SME growth and identifying the challenges that hinder access to credit in Andhra Pradesh. By employing statistical tools and Correspondence Analysis, this study evaluates the preferences for various financing sources, such as bank loans, grants, and self-funding, while exploring the impact of challenges, such as high borrowing costs and regulatory burdens. These findings are intended to provide actionable insights for policymakers, financial institutions, and SME stakeholders to enhance access to financing and foster a supportive ecosystem for SME growth[7].

The significance of this study lies in its potential to bridge the gap between financial accessibility and SME sustainability[8]. While previous studies have highlighted the importance of SMEs in economic development, limited attention has been paid to understanding the unique financing needs and barriers that SMEs face in Andhra Pradesh[9], [10]. This study seeks to fill this gap by comprehensively analyzing financing sources, challenges, and their influence on SME growth[11]. By addressing these critical issues, this study contributes to formulating policies and strategies that enable SMEs to achieve sustainable development, thereby reinforcing their role as drivers of economic progress in Andhra Pradesh. This study analyzes the relationship between access to financing and SME growth in Andhra Pradesh, focusing on key financing sources, challenges such as credit access, and their impact on financial performance. The scope of this study encompasses SMEs across diverse industries, highlighting their financing preferences and barriers. By identifying the critical factors influencing growth, this study aims to provide actionable insights for policymakers and financial institutions to enhance financing accessibility and support SME sustainability and economic contribution in the region.

3. Literature Review

Access to financing is widely recognized as the cornerstone of the growth and sustainability of small and medium-sized enterprises (SMEs)[12]. Financing enables SMEs to invest in technology, expand operations, and meet their working capital needs, making it a critical driver of economic growth and innovation[13]. Research has consistently highlighted three primary financing sources for SMEs: bank loans, self-funding, and grants.

Bank loans are the most common source of financing for SMEs globally and in India. Studies show that bank loans provide liquidity[14]. SMEs need to scale their operations and invest in modernization. However, access to bank loans is often restricted by stringent collateral requirements, lengthy approval processes, and high interest rates. Over 50% of SMEs struggle to secure bank financing because of insufficient collateral or lack of credit history. This limitation has forced many SMEs to explore alternative funding sources. Self-funding remains a vital source of capital for SMEs,

especially those in their early stages or those operating in rural or underserved areas. Entrepreneurs often rely on personal savings, family support, or retained earnings to finance their business [15]. While self-funding allows SMEs to maintain ownership and avoid debt, it is often insufficient for long-term growth and large-scale investments. Self-funding emphasizes that reliance on it can restrict growth potential, especially in competitive industries where rapid scaling is critical.

Grants and government subsidies provide another crucial avenue for SME financing, particularly in emerging economies like India. Programs such as Pradhan Mantri Mudra Yojana (PMMY) have significantly promoted financial inclusion and supported SMEs through low-cost loans and subsidies. However, studies suggest that access to such programs is uneven, with smaller enterprises in rural areas facing more significant challenges in navigating bureaucratic processes or meeting eligibility criteria. Although grants and subsidies help bridge funding gaps, their efficacy often depends on targeted implementation and awareness among SME owners.

Despite the availability of these financing sources, SMEs in India face several challenges that hinder access to credit [16]. High borrowing costs remain a significant barrier, particularly for small enterprises with limited bargaining power. Studies indicate that SMEs often face interest rates 2–3% higher than those available to larger corporations, adding to their financial strain. Stringent collateral requirements and complex regulatory frameworks make formal credit inaccessible to many SMEs. Nearly 40% of SMEs in developing economies cite credit inaccessibility as the primary barrier to growth. Recent trends in SME financing have highlighted the growing focus on financial inclusion and alternative funding models [17]. Digital lending platforms, peer-to-peer lending, and crowdfunding are emerging as viable options for SMEs, offering quicker access to credit with fewer bureaucratic hurdles. However, these options remain underutilized in regions like Andhra Pradesh, where awareness and digital infrastructure are limited. This literature review underscores the urgent need for tailored financial solutions to address SMEs' unique challenges [18]. Policymakers can foster sustainable growth in the SME sector by improving access to affordable credit, streamlining regulatory processes, and promoting alternative financing models. These insights provide a foundation for exploring the influence of financing on SME growth in Andhra Pradesh.

3.1 Existing research

Malepati et al. [19] emphasize that MSMEs remain a vital subject for academic and policy analysis, particularly in understanding growth dynamics. Their study investigates the challenges in accessing financial resources, considering variables such as business size, ownership type, and business type, focusing on the Guntur and Krishna districts of Andhra Pradesh. Regression analysis revealed a strong positive relationship between business size and financial accessibility, suggesting that larger firms have better access to funding. Ownership and business types have a moderate impact. The study concludes that business size significantly enhances access to financial resources, serving as a critical enabler for MSME growth compared with other factors. Basheer and Beg [20] highlight the critical role of MSMEs as drivers of economic growth, contributing significantly to GDP and serving as pillars of development, especially in countries like India. Despite their importance, MSMEs face challenges, such as limited access to bank finance, procurement issues, marketing constraints, and inadequate technology. Their study focused on identifying problems in accessing finance in Andhra Pradesh and examining its impact on MSME growth. The findings emphasize that these challenges vary across regions, sectors, and individual enterprises, underscoring the need for tailored financial solutions to address these barriers.

Ainin et al. [21] investigated the factors influencing Facebook usage among SMEs and its impact on financial and non-financial performance. The study, conducted with 259 Malaysian SMEs, used a partial least squares (PLS) method to analyze the data. The findings indicate that Facebook usage

positively affects financial performance and enhances non-financial outcomes such as cost reduction, improved customer relations, and better information accessibility. Key factors influencing Facebook adoption include compatibility, cost-effectiveness, and interactivity. Despite limited generalizability due to sample constraints, this study highlights the significant role of Facebook in improving business activities and offers valuable insights for SMEs that adopt social media strategies. Shah Alam [22] conducted an empirical analysis to explore factors influencing internet adoption among SMEs. Surveying 465 SMEs from Malaysia's Klan Valley, this study tested seven hypotheses and found significant relationships between Internet adoption and factors such as managerial characteristics, perceived benefits, organizational culture, technological competency, and cost of adoption. Interestingly, factors such as language and Web growth had no significant impact. This study emphasizes the role of highly educated managers in driving adoption and provides valuable insights for stakeholders promoting Internet usage, offering guidance to better align strategies with SMEs' needs and managerial perceptions.

Walsh and Lipinski [23] examined the role of marketing in SMEs as a driver of competitive advantage and its overall influence within the organization. Based on a study of 100 SMEs in the mid-Atlantic region of the United States, the findings reveal that marketing functions are less developed and influential than those of larger corporations. Factors such as market type (consumer) and firm orientation (hierarchical) enhance the marketing influence. This study highlights the need for marketers to play a more prominent role in decision-making processes. Despite its limited sample size, this study emphasizes the importance of marketing in fostering competitiveness within SMEs. Zanjurne [24] highlights the crucial role of MSMEs in achieving socio-economic objectives such as economic growth, employment generation, entrepreneurship, and export promotion. The MSME sector is recognized as the backbone of the Indian economy, contributing significantly to industrial development and inclusive growth. It plays a pivotal role in meeting the Nation Manufacturing Policy's target of 25% GDP contribution from manufacturing by 2022, supported by initiatives like "Make in India." This study emphasizes the sector's impact on employment, exports, and manufacturing output, underscoring its importance for sustainable economic growth and national development.

4. Methodology

This study investigates the influence of access to financing on SME growth in Andhra Pradesh, using a structured methodology that integrates a comprehensive dataset and robust statistical tools. The analysis focuses on understanding the preferences for financing sources, the challenges SMEs face, and their impact on business growth and sustainability.

4.1 Dataset

The dataset includes information from 200 SMEs across Andhra Pradesh, covering diverse industries, such as textiles, pharmaceuticals, agriculture, and IT. The data collection involved structured questionnaires and secondary sources, including quantitative and categorical variables relevant to financing and growth. The sample provides a balanced representation of SMEs from urban and rural areas, thus capturing the unique financial dynamics of the state.

4.2 Key Variables:

i. Financing Sources:

- **Bank Loans:** Utilization and prioritization by SMEs.
- **Grants:** Government access and institutional support mechanisms.
- **Self-funding:** Dependence on personal savings or retained earnings.

ii. Challenges:

- **Interest Rates:** Impact of borrowing costs on financial stability.
- **Credit Access:** Barriers to obtaining formal credit from financial institutions.
- **Regulatory Burdens:** Issues related to compliance and bureaucratic hurdles.

iii. **Performance Indicators:**

- **Turnover:** Financial growth metric.
- **Financial Performance Rating:** SME owners' self-assessment of overall financial health.

4.3 Statistical Tools

i. Descriptive Statistics

Descriptive statistics were used to summarize the key metrics, such as turnover, borrowing, and financial performance ratings. The mean, median, mode, and standard deviation measures helped identify trends and variability within the dataset. This tool overviews SME financial health and highlights differences in borrowing strategies and economic outcomes.

ii. Frequency Distribution Analysis

Frequency distribution analysis was applied to categorical variables such as financing sources and challenges to determine the proportion of SMEs that prioritize different options or face specific issues. This analysis identifies the most common preferences for financing sources and highlights key challenges affecting SMEs, such as credit access and high interest rates.

iii. Correlation Analysis

The correlation analysis examined the relationships between turnover, borrowing, and financial performance ratings. Pearson's correlation coefficient was used to measure the strength and significance of these relationships. This analysis evaluates how financial metrics influence one another and identifies gaps in which other factors may play a role in SME growth. By applying these tools, this study provides valuable insights into SME financing preferences, challenges, and their impact on financial outcomes. This offers a basis for targeted interventions to enhance SME sustainability in Andhra Pradesh.

5. Results and Discussion

5.1 Analysis of financing sources

Analysis is conducted to explore the various funding sources in SMEs using SPSS software and given in Table 1 of key variables related to SME financing and growth in Andhra Pradesh. Table 1 shows critical metrics, such as turnover, borrowing, financial performance rating, financing source priorities, and challenges faced by SMEs. The essential variables of SMEs in AP are as follows.

Table 1. Statistical Summary of SME Financing and Growth Variables

| | | Statistics | | | | | | | |
|----------------|---------|--------------------|--------------|------------------------------|-----------------------------------|--------------------------------|--------------------------------------|-----------------------------|--------------------------------|
| | | Turnover Cr | Borrowing Cr | Financial Performance Rating | Finance Source Bank Loan Priority | Finance Source Grants Priority | Finance Source Self Funding Priority | Challenges Access to Credit | Challenges High Interest Rates |
| N | Valid | 200 | 200 | 200 | 201 | 201 | 201 | 201 | 201 |
| | Missing | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Mean | | 24.8265 | 5.1667 | 2.91 | | | | | |
| Median | | 24.7950 | 5.2800 | 3.00 | | | | | |
| Mode | | 19.86 ^a | 8.73 | 1 | | | | | |
| Std. Deviation | | 13.94039 | 3.01357 | 1.420 | | | | | |

a. Multiple modes exist. The smallest value is shown

i. Turnover (₹ Cr)

- Mean: ₹24.83 Cr indicates that SMEs, on average, generate moderate annual turnover.
- Median: ₹24.79 Cr, close to the mean, suggests a relatively balanced turnover distribution.
- Mode: ₹19.86 Cr is the most frequently observed turnover value, reflecting a cluster of SMEs with similar revenue levels.
- Standard Deviation: ₹13.94 Cr shows significant variability, with some SMEs achieving high revenue while others underperform.

Implications: Variation in turnover among SMEs indicates significant differences in financial health. While some SMEs achieve high revenue, others face challenges in sustaining growth. Financial strategies should focus on supporting underperforming SMEs through targeted interventions to address this disparity, helping them improve their operations and achieve sustainable economic stability.

ii. Borrowing (₹ Cr)

- **Mean:** ₹5.17 Cr indicates moderate reliance on borrowing for SME operations.
- **Median:** ₹5.28 Cr suggests borrowing levels are symmetrically distributed across SMEs.
- **Mode:** ₹8.73 Cr reflects a cluster of SMEs that prefer higher borrowing levels, likely for expansion.
- **Standard Deviation:** ₹3.01 Cr indicates variability in borrowing habits.

Implications: The variability in borrowing among SMEs reflects diverse financial strategies and capacities. While some SMEs leverage borrowing effectively for growth, others may struggle with debt management or access to credit. This underscores the need for customized financial support and education to help SMEs optimize borrowing and improve financial resilience.

iii. Financial Performance Rating

- **Mean:** 2.91 suggests an average financial performance rating close to moderate levels.
- **Median:** 3.00 confirms a central tendency around the moderate rating.
- **Mode:** 1 indicates a significant portion of SMEs with lower performance ratings.
- **Standard Deviation:** 1.42 shows variability, indicating differing financial success among SMEs.

Implications: SMEs with low financial performance ratings can benefit from targeted interventions such as improved access to affordable credit. Such support would enable these businesses to invest in growth opportunities, enhance operations, and stabilize their financial health, ultimately helping them improve their performance and contribute more effectively to economic development.

iv. Financing Sources

- **Finance_Source_Bank_Loan_Priority, Finance_Source_Grants_Priority, and Finance_Source_Self_Funding_Priority**

- These categorical variables require ranking or frequency analysis to determine SME preferences for financing sources.

Implications: Understanding SMEs' preferred financing sources, such as bank loans, through tools such as the Henry Garrett Ranking, can guide targeted financial support strategies. By prioritizing the

most favored options, policymakers and financial institutions can develop tailored products and services, ensuring better accessibility and aligning financial resources with SMEs’ specific growth needs.

v. Challenges

- **Challenges_Access_to_Credit, Challenges_High_Interest_Rates, Challenges_Regulatory_Burden**

- These categorical variables require frequency and cross-tabulation analyses to understand the most pressing issues.

Implications:Policy interventions should address the challenges that are most commonly reported by SMEs.By targeting critical issues, such as access to credit or regulatory burdens, policymakers can create a supportive environment that reduces barriers, enhances operational efficiency, and promotes sustainable growth for SMEs, ultimately boosting their economic contributions.

5.2 Frequency Distribution Analysis

The frequency distribution of key variables related to SMEs was analyzed using the SPSS software.The results presented in Tables 2-7 and bar charts (Figs. 1-6), provide insights into financing sources, performance ratings, and challenges faced by SMEs.This analysis highlights critical patterns and distributions, helping identify key areas for intervention and support.

Table 2 and Fig. 1 depict the priority SMEs assign to bank loans as a financing source. Among 200 responses, 52 SMEs (25.9%) marked "No Priority," making it the most frequent choice, followed by "Low Priority" at 25.4% and "Moderate Priority" at 24.4%. Only 48 SMEs (23.9%) assigned "High Priority" to bank loans. One response was categorized as invalid or missing. These results suggest a relatively low reliance on bank loans among SMEs, possibly because of challenges such as high interest rates or stringent collateral requirements.This highlights the need to address the barriers to enhancing bank loan accessibility.

Table 2 Frequency Distribution of Finance_Source_Bank_Loan_Priority

| Finance_Source_Bank_Loan_Priority | | | | | |
|-----------------------------------|----------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | | 1 | .5 | .5 | .5 |
| | High | 48 | 23.9 | 23.9 | 24.4 |
| | Low | 51 | 25.4 | 25.4 | 49.8 |
| | Moderate | 49 | 24.4 | 24.4 | 74.1 |
| | No | 52 | 25.9 | 25.9 | 100.0 |
| | Total | 201 | 100.0 | 100.0 | |

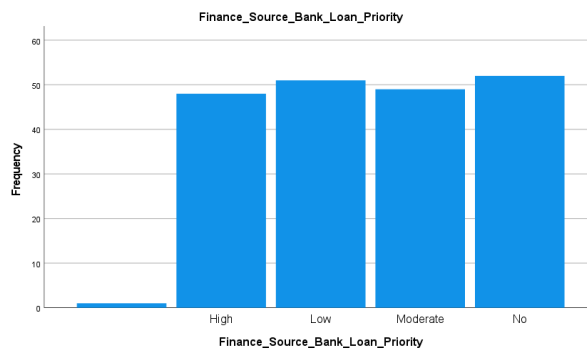


Fig. 1. Bar graph of Frequency Distribution of Finance_Source_Bank_Loan_Priority

Table 3 and Fig. 2 illustrate SMEs' priorities for grants as a financing source. Of the 200 responses, 61 SMEs (30.3%) assigned a "High Priority" to grants, making it the most preferred choice. This was followed by 55 SMEs (27.4%) with "Low Priority" and 44 SMEs (21.9%) with "Moderate Priority." A smaller proportion, 40 SMEs (19.9%), indicated "No Priority." One response was either missing or invalid. The results suggest a significant reliance on grants as a financial source, likely because of the perceived benefits of non-repayable funding. This highlights the importance of expanding grant access for SME growth.

Table 3 Frequency Distribution of Finance_Source_Grants_Priority

| | | Finance_Source_Grants_Priority | | | |
|-------|----------|--------------------------------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | | 1 | .5 | .5 | .5 |
| | High | 61 | 30.3 | 30.3 | 30.8 |
| | Low | 55 | 27.4 | 27.4 | 58.2 |
| | Moderate | 44 | 21.9 | 21.9 | 80.1 |
| | No | 40 | 19.9 | 19.9 | 100.0 |
| | Total | 201 | 100.0 | 100.0 | |

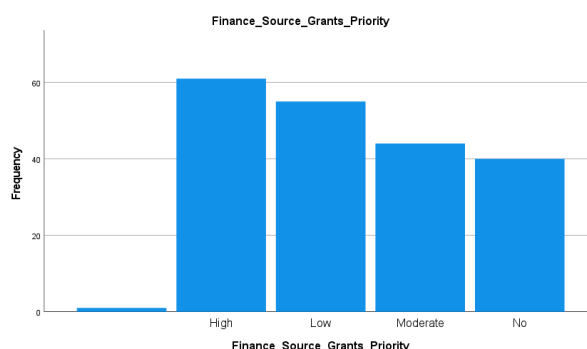


Fig. 2. Bar graph of Frequency Distribution of Finance_Source_Grants_Priority

Table 4 and Fig. 3 display the prioritization of SMEs self-funding as financing sources. Out of 200 responses, 54 SMEs (26.9%) assigned "No Priority," while 53 SMEs (26.4%) considered it a "Moderate Priority." Additionally, 47 SMEs (23.4%) were assigned "High Priority," and 46 SMEs

(22.9%) were rated as "Low Priority." One response was either missing or invalid. These results reveal that, while self-funding is moderately prioritized by many SMEs, a significant portion does not rely on it as a primary source. This could indicate a reliance on external financing sources for scalability and growth, especially in competitive industries.

Table 4 Frequency Distribution of Finance_Source_Self_Funding_Priority

| | | Finance_Source_Self_Funding_Priority | | | |
|-------|----------|--------------------------------------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | | 1 | .5 | .5 | .5 |
| | High | 47 | 23.4 | 23.4 | 23.9 |
| | Low | 46 | 22.9 | 22.9 | 46.8 |
| | Moderate | 53 | 26.4 | 26.4 | 73.1 |
| | No | 54 | 26.9 | 26.9 | 100.0 |
| | Total | 201 | 100.0 | 100.0 | |



Fig. 3 Bar graph of Frequency Distribution of Finance_Source_Self_Funding_Priority

Table 5 and Fig. 4 illustrate SMEs' responses to the challenges in accessing credit. Of the 200 respondents, 105 SMEs (52.2%) reported no challenges, while 95 SMEs (47.3%) acknowledged difficulties in obtaining credit. One response was categorized as either missing or invalid. These results indicate that while a slight majority of SMEs do not face access-to-credit challenges, a significant proportion still struggle with barriers such as stringent requirements or limited credit availability. Addressing these obstacles is critical to supporting SME growth and ensuring equitable access to financial resources in Andhra Pradesh.

Table 5 Frequency Distribution of Challenges in Access to Credit

| | | Challenges_Access_to_Credit | | | |
|-------|-------|-----------------------------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | | 1 | .5 | .5 | .5 |
| | No | 105 | 52.2 | 52.2 | 52.7 |
| | Yes | 95 | 47.3 | 47.3 | 100.0 |
| | Total | 201 | 100.0 | 100.0 | |

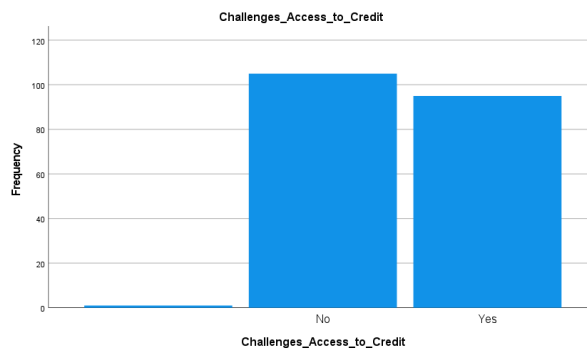


Fig. 4 Bar graph of Frequency Distribution of Challenges in Access to Credit

Table 6 and Fig. 5 show the responses of SMEs to challenges from high interest rates. Of the 200 responses, 103 SMEs (51.2%) acknowledged high interest rates as a challenge, while 97 SMEs (48.3%) reported no issues. One response was either missing or invalid. The results highlight that many SMEs experience difficulties owing to high borrowing costs, which can impact financial sustainability and growth opportunities. Addressing this issue by offering lower-interest financial products or targeted subsidies could significantly ease the financial burden on SMEs and support their expansion.

Table 6 Frequency Distribution of Challenges Related to High Interest Rates

| Challenges_High_Interest_Rates | | | | | |
|--------------------------------|-------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | | 1 | .5 | .5 | .5 |
| | No | 97 | 48.3 | 48.3 | 48.8 |
| | Yes | 103 | 51.2 | 51.2 | 100.0 |
| | Total | 201 | 100.0 | 100.0 | |

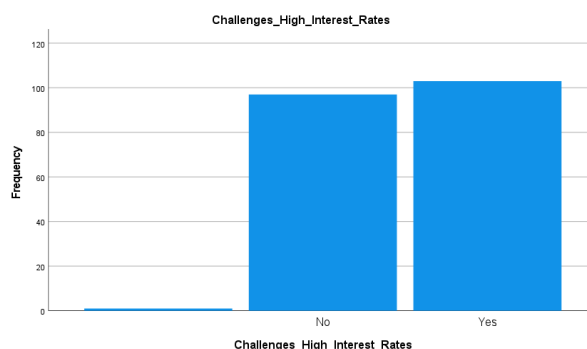


Fig. 5 Bar graph of Frequency Distribution of Challenges Related to High Interest Rates

Table 7 and Fig. 6 illustrate SMEs' responses regarding regulatory burden as a challenge. Among the 200 respondents, 104 SMEs (51.7%) reported no challenges, while 96 SMEs (47.8%) identified regulatory burdens as barriers. One response was either missing or invalid. The data show a nearly balanced split, with many SMEs facing difficulties due to complex regulations, compliance requirements, or bureaucratic hurdles. Simplifying regulatory processes and providing better support

for SMEs to meet compliance standards can reduce these burdens and enhance their operational efficiency and growth potential.

Table 7 Frequency Distribution of Challenges Related to Regulatory Burdens

| Challenges_Regulatory_Burdens | | | | | |
|-------------------------------|-------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | | 1 | .5 | .5 | .5 |
| | No | 104 | 51.7 | 51.7 | 52.2 |
| | Yes | 96 | 47.8 | 47.8 | 100.0 |
| | Total | 201 | 100.0 | 100.0 | |

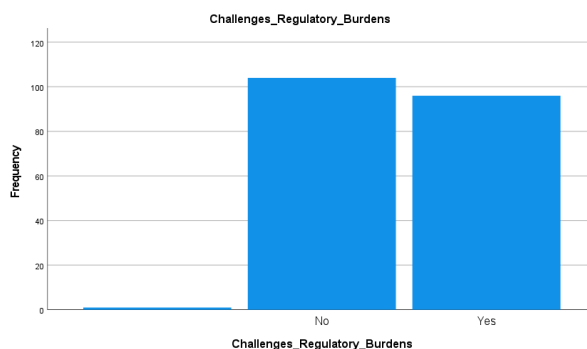


Fig. 6. Bar graph of Frequency Distribution of Challenges Related to Regulatory Burdens

5.3 Coreelation analysis

Table 8 presents a correlation analysis among the three key variables: turnover (₹ Cr), Borrowing (₹ Cr), and Financial Performance Rating. The Pearson Correlation coefficients indicate the strength and direction of the linear relationships between these variables, and the significance values (Sig. 2-tailed) was used to assess the statistical relevance of these relationships.

Key Observations:

i. Turnover and Borrowing ($r = 0.096$, $\text{Sig.} = 0.175$):

The Pearson's correlation coefficient (0.096) shows a weak positive relationship between turnover and borrowing. However, the p-value (0.175) exceeded the threshold of 0.05, indicating that this relationship was not statistically significant. This finding suggests that higher borrowing levels do not necessarily correlate with higher turnover among SMEs.

ii. Turnover and Financial Performance Rating ($r = 0.034$, $\text{Sig.} = 0.633$):

The correlation coefficient (0.034) shows a weak positive relationship between turnover and financial ratings. This relationship was not statistically significant, with a p-value of 0.633 (greater than 0.05). This implies that SMEs' turnover does not directly reflect their perceived financial performance.

iii. The borrowing and financial performance ratings (r = 0.058, Sig. = 0.413):

The correlation coefficient (0.058) indicates a weak positive relationship between borrowing and financial ratings. The p-value (0.413) is not statistically significant, showing no firm evidence of an association between these variables.

Implications:

The weak and statistically insignificant correlations suggest that factors beyond borrowing and turnover might influence SMEs' financial performance ratings. This analysis emphasizes the need for additional variables, such as market dynamics, operational efficiency, and grant access, to comprehensively explain SME growth. This analysis highlights the minimal linear associations among the selected variables, prompting further research into the underlying factors affecting SME performance.

Table 8. Correlation Analysis Between Turnover, Borrowing, and Financial Performance Rating

| Correlations | | | | |
|------------------------------|---------------------|-------------|--------------|------------------------------|
| | | Turnover_Cr | Borrowing_Cr | Financial_Performance_Rating |
| Turnover_Cr | Pearson Correlation | 1 | .096 | .034 |
| | Sig. (2-tailed) | | .175 | .633 |
| | N | 200 | 200 | 200 |
| Borrowing_Cr | Pearson Correlation | .096 | 1 | .058 |
| | Sig. (2-tailed) | .175 | | .413 |
| | N | 200 | 200 | 200 |
| Financial_Performance_Rating | Pearson Correlation | .034 | .058 | 1 |
| | Sig. (2-tailed) | .633 | .413 | |
| | N | 200 | 200 | 200 |

6. Conclusion

This study highlights the critical role of financing in driving the growth and sustainability of Small and Medium Enterprises (SMEs) in Andhra Pradesh. Through a detailed analysis of key financial metrics and challenges, this study provides actionable insights into SMEs' barriers and their implications for growth. The findings reveal significant variability in SME financial health, as indicated by differences in turnover and borrowing patterns. While some SMEs effectively leverage financing to enhance performance, others struggle with limited access to credit, high interest rates, and regulatory burdens. Frequency distribution analysis underscores the prioritization of grants as a key financing source, followed by self-funding and bank loans. However, challenges, such as stringent collateral requirements and bureaucratic hurdles, often restrict access to these resources. The correlation analysis shows weak and statistically insignificant relationships between turnover, borrowing, and financial performance ratings, suggesting that other external or internal factors significantly influence SME growth. This calls for a deeper exploration of variables, such as market conditions, operational efficiency, and access to non-traditional financing options. This study emphasized the importance of targeted interventions to address these challenges. Policymakers and

financial institutions must collaborate to design SME-friendly financial products, reduce borrowing costs, and streamline the regulatory processes. Financial literacy among SME owners is also crucial for better decision making and effective resource utilization. By addressing these barriers, Andhra Pradesh can create a more inclusive and supportive ecosystem for SMEs, enabling them to thrive and significantly contribute to the region's economic development. Future research should explore the impact of emerging financing models, such as digital lending and crowdfunding, to further enhance SME access to capital. This study can serve as a foundation for policymakers and stakeholders to drive significant changes in the financing landscape of SMEs.

References

- [1] K. Sudarsan, P. Venugopal, and D. Himachalam, "Operational Performance of Andhra Pradesh State Financial Corporation (APSFC)-An Analytical Study," *SEDME (Small Enterp. Dev. Manag. Ext. Journal) A Worldw. Wind. MSME Stud.*, vol. 35, no. 3, pp. 25–35, 2008, doi: 10.1177/0970846420080304.
- [2] S. Kumar and P. Rao, "Financing patterns of SMEs in India during 2006 to 2013 – an empirical analysis," *J. Small Bus. Entrep.*, vol. 28, no. 2, pp. 97–131, Mar. 2016, doi: 10.1080/08276331.2015.1132513.
- [3] R. J. Yadav, "Issues in SME Financing," 2015.
- [4] N. Sandhu and J. Hussain, "Entrepreneurship the mediating role of finance and entrepreneurial education for small farmers in developing countries: evidence from India," *Int. J. Entrep. Behav. Res.*, vol. 27, no. 6, pp. 1403–1422, Jan. 2021, doi: 10.1108/IJEBr-09-2020-0600.
- [5] C. Romano and J. Ratnatunga, "The role of marketing," *Eur. J. Mark.*, vol. 29, no. 7, pp. 9–30, Jan. 1995, doi: 10.1108/03090569510094982.
- [6] I. Copernicus, P. Panel, and O. J-gage, "DATA WAREHOUSING AND TESTING," *Int. J. Res. Commer. IT Manag.*, vol. 2, no. 1041, 2012.
- [7] K. Rajamani, N. A. Jan, A. K. Subramani, and A. N. Raj, "Access to Finance: Challenges Faced by Micro, Small, and Medium Enterprises in India," *Eng. Econ.*, vol. 33, no. 1, pp. 73–85, 2022, doi: 10.5755/j01.ee.33.1.27998.
- [8] S. N. Rajesh Raj and M. K. Mahapatra, "Growth and productivity performance of small manufacturing enterprises (SMEs)," *J. Indian Bus. Res.*, vol. 1, no. 1, pp. 39–56, Jan. 2009, doi: 10.1108/17554190910963190.
- [9] Bilal, Mohd., et al. "On Generalized Weyl Conformal Curvature Tensor in Para-Kenmotsu Manifolds." *Results in Nonlinear Analysis*, vol. 7, no. 3, 2024, pp. 55–64.
- [10] Kavitha, M. "Environmental Monitoring Using IoT-Based Wireless Sensor Networks: A Case Study." *Journal of Wireless Sensor Networks and IoT* 1.1 (2024): 32-36.
- [11] L. Vachya and P. B. Kamaiah, "Microfinance Impact on Socio-Economic Empowerment: A special Reference to Andhra Pradesh," *Vachyah Kamaiah /International J. Financ. Bank. Stud.*, vol. 4, no. 1, pp. 2147–4486, 2015, [Online]. Available: www.ssbfn.com
- [12] S. Samineni and K. Ramesh, "Measuring the Impact of Microfinance on Economic Enhancement of Women: Analysis with Special Reference to India," *Glob. Bus. Rev.*, vol. 24, no. 5, pp. 1076–1091, May 2020, doi: 10.1177/0972150920923108.
- [13] K. Prasanthi and M. Bhaskara Rao, "Motives, Drivers, and Barriers for Internationalization: A Study of SMEs in Andhra Pradesh BT - Transnational Entrepreneurship: Issues of SME Internationalization in the Indian Context," M. J. Manimala, K. P. Wasdani, and A. Vijaygopal, Eds. Singapore: Springer Singapore, 2019, pp. 213–239. doi: 10.1007/978-981-10-6298-8_10.
- [14] S. K. Mallick, A. Sarkar, K. K. Roy, T. Duttachaudhuri, and A. Chakrabarti, "Dynamics of emerging India's banking sector assets: A simple model," *J. Asset Manag.*, vol. 11, no. 1, pp. 62–70, 2010, doi: 10.1057/jam.2010.1.
- [15] G. T. Naidu and S. S. S. Sri, "Effect of cash management practices on financial performance of small and medium enterprises in Visakhapatnam and Vizianagaram districts of Andhra Pradesh, India," *Eur. J. Soc. Sci. Stud.*, vol. 5, no. 6, pp. 142–151, 2020, doi: 10.46827/ejsss.v5i6.951.
- [16] N. Yuko, P. Jesim, and S. Mandira, "What hinders and what enhances small enterprises' access to formal credit in India?," *Rev. Dev. Financ.*, vol. 5, no. 1, pp. 43–52, Jun. 2015, doi: 10.1016/j.rdf.2015.05.002.

- [17] K Uma Devi and Lakshmi Narasaiah, "Women empowerment through self-help groups: An empirical study in Kurnool district of Andhra Pradesh," *Int. J. Appl. Res.*, vol. 3, no. 1, pp. 101–105, 2017.
- [18] N, Ravi, and Swanand Kulkarni. "Smart Ways to Catch the Abutment DRCs at IP Level." *Journal of VLSI Circuits and Systems*, vol. 6, no. 1, 2024, pp. 51-54.
- [19] Rahim, Robbi. "Scalable Architectures for Real-Time Data Processing in IoT-Enabled Wireless Sensor Networks." *Journal of Wireless Sensor Networks and IoT* 1.1 (2024): 28-31.
- [20] Rahim, Robbi. "Adaptive Algorithms for Power Management in Battery-Powered Embedded Systems." *SCCTS Journal of Embedded Systems Design and Applications* 1.1 (2024): 20-24.
- [21] S. Ainin, F. Parveen, S. Moghavvemi, N. I. Jaafar, and N. L. Mohd Shuib, "Factors influencing the use of social media by SMEs and its performance outcomes," *Ind. Manag. Data Syst.*, vol. 115, no. 3, pp. 570–588, Jan. 2015, doi: 10.1108/IMDS-07-2014-0205.
- [22] S. Shah Alam, "Adoption of internet in Malaysian SMEs," *J. Small Bus. Enterp. Dev.*, vol. 16, no. 2, pp. 240–255, Jan. 2009, doi: 10.1108/14626000910956038.
- [23] Karshoğlu, Dilara. "On the Blow-Up Solutions to a Fourth-Order Pseudo-Parabolic Equation with Gradient Non-Linearity." *Results in Nonlinear Analysis*, vol. 7, no. 3, 2024, pp. 94–108.
- [24] P. Zanjurne, "Growth and Future Prospects of MSME in India," *Int. J. Adv. Eng. Manag. Sci.*, vol. 4, no. 8, pp. 608–614, 2018, doi: 10.22161/ijaems.4.8.5.