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ARTIFICIAL INTELLIGENCE, FINANCIAL INCLUSION, AND DEBT FINANCING IN SAUDI ARABIA: SUPPORTING SAUDI VISION 2030

INTELIGÊNCIA ARTIFICIAL, INCLUSÃO FINANCEIRA E FINANCIAMENTO POR DÍVIDA NA ARÁBIA SAUDITA: APOIANDO A VISÃO SAUDITA 2030

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Abstract
Financial inclusion is seen as one of the pillars of economic diversification and sustainable development in Saudi Arabia, with particular reference to the Saudi Vision 2030 initiative. Expanding access to credit and debt financing for individuals, small and medium enterprises, and the less financially included remains important for entrepreneurship, inequality reduction, and private sector growth. Nevertheless, the application of credit assessment tools is seen to be excluding high-value credit applicants owing to the lack of credit history. This article seeks to investigate the role played by artificial intelligence in enhancing financial inclusion and access to debt financing in Saudi Arabia. It is believed that the application of machine learning algorithms, alternative data analytics, and credit scoring tools can enhance the expansion of access to credit and debt financing. Financial inclusion is seen to be improved through the application of predictive models, digital lending tools, and data-driven decision-making tools. Based on the investigation, it is evident that the application of credit evaluation tools is important in enhancing financial inclusion and access to credit and debt financing. Furthermore, the investigation highlights the importance of considering the governance, regulatory, and ethical issues related to the application of lending tools. As the government seeks to achieve its economic objectives through the application of technology innovation, this research highlights the importance of enhancing access to credit and debt financing through the application of artificial intelligence tools in the Saudi Arabian economy.

Keywords: Artificial Intelligence. Financial Inclusion. Debt Financing. Digital Lending. Credit Risk Assessment. Machine Learning.

Resumo
A inclusão financeira é considerada um dos pilares da diversificação econômica e do desenvolvimento sustentável na Arábia Saudita, com referência especial à iniciativa Visão Saudita 2030. Ampliar o acesso ao crédito e ao financiamento por meio de dívida para pessoas físicas, pequenas e médias empresas e para os menos incluídos financeiramente continua sendo importante para o empreendedorismo, a redução da desigualdade e o crescimento do setor privado. No entanto, observa-se que a aplicação de ferramentas de avaliação de crédito está excluindo candidatos a crédito de alto valor devido à falta de histórico de crédito. Este artigo busca investigar o papel desempenhado pela inteligência artificial no aprimoramento da inclusão financeira e do acesso ao financiamento por dívida na Arábia Saudita. Acredita-se que a aplicação de algoritmos de aprendizado de máquina, análises de dados alternativos e ferramentas de pontuação de crédito possa ampliar o acesso ao crédito e ao financiamento por dívida. Considera-se que a inclusão financeira seja aprimorada por meio da aplicação de modelos preditivos, ferramentas de empréstimo digital e ferramentas de tomada de decisão baseadas em dados. Com base na investigação, fica evidente que a aplicação de ferramentas de avaliação de crédito é importante para melhorar a inclusão financeira e o acesso ao crédito e ao financiamento por dívida. Além disso, a investigação destaca a importância de considerar as questões de governança, regulatórias e éticas relacionadas à aplicação de ferramentas de empréstimo. À medida que o governo busca atingir seus objetivos econômicos por meio da aplicação de inovação tecnológica, esta pesquisa destaca a importância de ampliar o acesso ao crédito e ao financiamento por dívida por meio da aplicação

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Alternative Data Analytics. Sme Financing. Fintech Innovation. Saudi Vision 2030.

de ferramentas de inteligência artificial na economia da Arábia Saudita.

Palavras-chave: *Inteligência Artificial. Inclusão Financeira. Financiamento por Dívida. Empréstimos Digitais. Avaliação de Risco de Crédito. Aprendizado de Máquina. Análise de Dados Alternativos. Financiamento de Pmes. Inovação em Fintech. Visão Saudita 2030.*

1 INTRODUCTION

Financial inclusion is one of the important pillars for the growth and development of emerging economies. Financial inclusion is important for the growth and development of emerging economies because it can reduce poverty and promote entrepreneurship. The expansion of financial services, including credit and debt financing, is one of the important pillars for the growth and development of the Saudi Arabian economy. The Saudi Arabian government has decided to transform the economy to make it diversified and dependent on the private sector. The expansion of financial services, including credit and debt financing, is important for the growth and development of the Saudi Arabian economy.

The banking infrastructure and digital economy in Saudi Arabia have developed significantly, but the availability of debt financing is still low. Financial institutions and banks consider the credit history and financial statements of individuals and firms to provide credit. Although this is important for the growth and development of the Saudi Arabian economy, it can also lead to exclusion. Excluding individuals and firms can lead to informational asymmetry. Artificial intelligence can play an important role in the growth and development of the Saudi Arabian economy. The role of artificial intelligence in the development of the Saudi Arabian economy is significant due to its potential to improve access to credit and debt financing. The role of artificial intelligence-based credit evaluation is significant due to its potential to improve access to credit and debt financing.

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debt financing. The role of artificial intelligence-based credit evaluation is significant due to its potential to improve access to credit and debt financing. The integration of artificial intelligence in the financial sector of Saudi Arabia is in sync with the overall digital transformation strategy of the Kingdom. The development of fintech platforms, digital banks, and online lending platforms is changing the overall dynamics of financial services in Saudi Arabia.

The development of credit scoring platforms, smart underwriting platforms, and data-driven loan approval platforms is gaining significant traction in the overall improvement of financial services in the Kingdom. In this context, not only is artificial intelligence improving the overall efficiency of the financial services sector in the Kingdom, but it is also aligning itself with the overall financial inclusion strategy of the Kingdom by removing barriers to entry for borrowers who have not been served by the conventional banking system.

Debt financing is an important factor in attaining the strategy of financial inclusion in the Kingdom. Easy access to credit helps SMEs invest in growth projects, technology, and human development. Easy access to credit helps individuals invest in homeownership, education, and entrepreneurship too. However, in attaining the strategy of financial inclusion, there is a need to maintain a balance between the risk of financial instability in accessing credit facilities. An improper implementation of the strategy of financial inclusion may lead to a high risk of default. Therefore, a need arises for proper governance and ethical considerations in implementing AI-based lending platforms. In the literature on financial inclusion, the main focus is on microfinance, mobile banking, and digital payment systems. However, there is limited literature on the application of artificial intelligence to promote financial inclusion through debt financing in emerging markets. Moreover, the literature on the application of machine learning algorithms in credit scoring indicates the performance of machine learning algorithms is high compared to credit scoring models. However, there is limited literature on the application of artificial intelligence to promote financial inclusion in Saudi Arabia. Financial systems in Saudi Arabia differ compared to other countries. Saudi Arabia is one of the few countries with both conventional and Islamic banks. Moreover, the Kingdom is witnessing rapid digitalization. Financial inclusion is also related to other economic development programs in Saudi Arabia. Therefore, the application of artificial intelligence to promote

financial inclusion through debt financing in Saudi Arabia is one important research issue to be addressed.

The aim of this research is to investigate the role of artificial intelligence in promoting financial inclusion through debt financing in Saudi Arabia. The research will mainly focus on exploring the contribution of artificial intelligence to the development of sustainable credit systems in Saudi Arabia. Moreover, the research will mainly focus on demonstrating the role of artificial intelligence in promoting financial inclusion through debt financing in Saudi Arabia and its contribution to economic development in Saudi Arabia in accordance with other economic development programs and economic reforms outlined in Saudi Vision 2030.

2 LITERATURE REVIEW

Financial inclusion is considered an important factor in the economic development process in most of the emerging economies of the world. The access of individuals as well as small-scale businesses to financial services, credit, and debt financing is considered an important factor in the economic development process in most of the emerging economies of the world. Most of the traditional financial systems as well as banks follow the traditional credit evaluation process, which is generally based on collateral, financial statement, as well as credit history. The traditional credit evaluation process is considered an important factor for most traditional financial systems as well as banks to avoid the risk of default. However, the traditional credit evaluation process may not be considered an important factor for small-scale businesses as well as individuals who are not able to get credit as well as debt financing due to the absence of financial statement as well as collateral. Most of the previous studies on financial inclusion are related to microfinance institutions, mobile banking, as well as digital payment systems. The previous studies on financial inclusion have shown that the digital system is helpful in facilitating the economic development process in most of the emerging economies of the world.

The mobile payment system is helpful in increasing transactional inclusion; however, the mobile payment system is not helpful in resolving the issue of debt finance. The access to credit as well as debt finance is possible only with the help of the risk

assessment system, which is capable of efficiently assessing the payment ability of the debtors even in uncertain conditions. Recently, artificial intelligence has come up as a revolutionary tool in credit risk assessment. Machine learning techniques like logistic regression, random forests, gradient boosting, and neural networks have shown their potential in predicting credit risk in a better way than traditional scoring techniques. The use of machine learning techniques is useful in managing a large number of variables in data, both structured and unstructured in nature. The use of machine learning techniques is useful in overcoming the problem of information asymmetry by recognizing patterns in borrowers' behaviors and their repayment potential in uncertain situations. The use of machine learning techniques is useful in managing those borrowers who are not strong in their credit history.

Alternative data analytics is another significant research finding in the field of inclusive finance. Alternative data analytics is a new and significant phenomenon in credit risk assessment systems. The use of alternative data analytics is different from traditional credit scoring techniques based on financial data alone. The use of alternative data analytics is useful in raising the accuracy of risk assessment and credit access without a significant increase in default risks. With regard to Islamic finance, there have been many important research findings that have highlighted the importance of ethical lending and risk-sharing models. In the context of Saudi Arabia, there is an important role for inclusive financing models to adhere to Shariah compliance norms. Even in conventional literature, there has been a lot of importance given to the role of Islamic finance in credit risk management and governance, but there has been little emphasis given to the potential of Islamic finance in incorporating Shariah compliance debt financing models with the help of AI models. Another important factor to be considered in this context is FinTech innovation. FinTech innovation in the context of digital lending models has shown positive results in the context of time and cost savings in the context of loan application processing. With regard to credit risk models, it has been found that with the help of FinTech innovation, there can be efficient facilitation in the context of financing Small and Medium-Scale Enterprises. Although there have been positive results in the conventional literature with regard to FinTech innovation in credit risk models, there have been some concerns raised by researchers about the transparency in decision-making models with the help of AI models. Although there have been positive results in the

conventional literature with regard to AI-driven financial inclusion models, there has been little emphasis given to the context of Saudi Arabia. Financial innovation can be observed in the context of the financial sector in Saudi Arabia. Although there has been little emphasis given to the application of AI-driven debt financing model…

Table 1

Summary of Literature on AI and Financial Inclusion

Research Area	**Key Findings**	**Identified Gap**
Traditional credit scoring	Risk-focused but exclusionary	Limited adaptability for thin-file borrowers
AI-based credit models	Improved prediction accuracy	Limited regional empirical studies
Alternative data analytics	Expands borrower assessment base	Governance and bias concerns
FinTech digital lending	Faster, lower-cost lending	Regulatory oversight challenges
Islamic finance risk	Ethical lending emphasis	Limited AI integration research

3 METHODOLOGY

3.1 Research design

The research is based on a quantitative approach to carry out an empirical research on the impact of AI systems on financial inclusion and debt financing accessibility in Saudi Arabia. This approach is based on predictive analysis and credit scoring models, as well as digital finance performance, to measure the effectiveness of AI systems in promoting financial inclusion and improving accessibility to credit facilities among the financially excluded and small and medium-sized enterprises.
The research design is based on a comparison of traditional methods for evaluating credits and AI systems for credit scoring to measure the effectiveness of AI systems in promoting financial inclusion and improving accessibility to credit facilities among the financially excluded and small and medium-sized enterprises.

3.2 Data collection and sample

The research is based on a dataset obtained from financial institutions and digital finance platforms operating in the Kingdom of Saudi Arabia.

- The study is based on the following datasets:
- Individual retail loan applications
- SME finance applications
- Approved and rejected loan records
- Loan repayment records
- Alternative data
- Macroeconomic factors

The study is based on a dataset obtained from multiple years to measure the effect of changes in the economy. Inconsistent and incomplete records are excluded to ensure the reliability of the results. Individual borrowers are classified into traditional credit segments, thin file, and no file.

3.3 Variable definition

The research is based on the definition of variables into dependent, independent, and control variables.

Dependent Variables

- Loan approval rates
- Default rates
- Financial inclusion index

Independent Variables

- AI-based credit score
- Alternative data utilization index
- Digital platform adoption level

Control Variables

- Borrower income level
- Business size
- Economic growth rate
- Inflation rate

Table 2

Variable Measurement Framework

Category	Variable	Measurement
Dependent	Approval Rate	Percentage of approved applications
Dependent	Default Rate	Non-performing loan ratio
Independent	AI Score	Machine learning risk probability
Independent	Alt-Data Index	Volume of non-traditional data used
Control	Income Level	Reported monthly income
Control	SME Size	Number of employees

3.4 Traditional credit assessment model

A basic logistic regression model is developed using traditional credit-related parameters, namely income, collateral, and repayment history. The model is developed as a reference point to compare the performance of the developed models against the proposed AI-based models.

3.5 AI-Based credit scoring models

In order to ensure the robustness of the developed model, the following machine learning algorithms are considered:

- Random Forest
- Gradient Boosting Machines
- Artificial Neural Networks
- Support Vector Machines

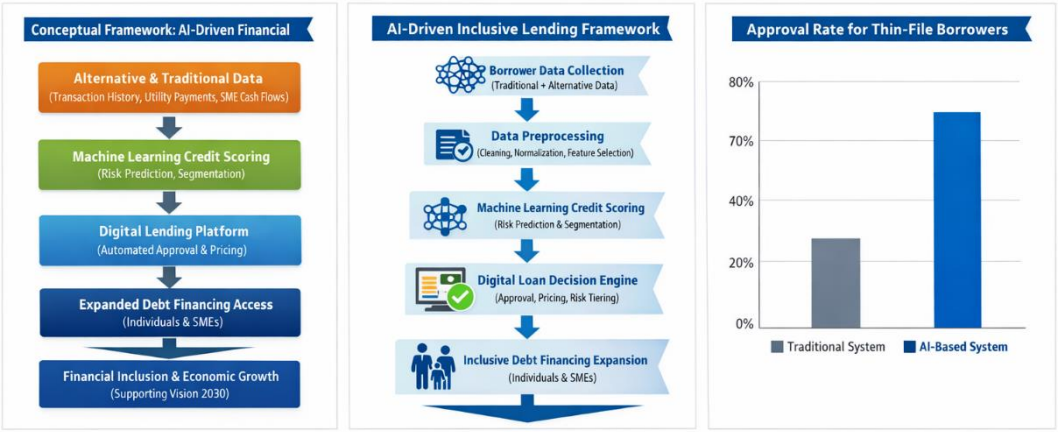
The data is split into training and testing sets, 70% and 30%, respectively. The cross-validation method is also considered to avoid overfitting. The feature selection method is also considered to identify the most important parameters, namely alternative behavioral parameters.

The following parameters are considered to evaluate the model:

- Accuracy
- Precision
- Recall

- F1-score
- AUC-ROC

Figure 1



4 RESULTS AND DISCUSSION

4.1 Descriptive overview of lending patterns

The empirical analysis starts with an overview of the lending patterns before and after the integration of AI-based credit scoring systems. The results indicate that there is a significant increase in the percentage of approved loans for the thin file and previously underserved borrowers after the integration of AI-based systems. The traditional credit scoring system approved a smaller percentage of loans for those borrowers who did not have a formal credit history, indicating that the system was heavily relying on collateral and repayment history.

There was also an increase in the number of approved loans for SME financing, especially for micro and new businesses. The inclusion of cash flow analysis and digital

payment history improved the segmentation of borrowers, helping to differentiate high-risk borrowers from viable ones.

Table 3

Loan Approval Rates Before and After AI Implementation

Borrower Segment	Traditional Model Approval	AI-Based Model Approval
Thin-File Individuals	28%	57%
Micro-SMEs	35%	62%
Established SMEs	68%	74%

The results show significant inclusion benefits, especially for thin file individuals and micro-SMEs. More importantly, however, the improvement in approval rates is accompanied by better risk differentiation rather than a lowering of standards.

4.2 Default rate and portfolio quality analysis

One of the biggest issues facing inclusive lending is whether greater inclusion leads to a lowering of overall portfolio quality. The analysis here shows that not only have approval rates been improved, but the default rate has not increased proportionally. In fact, errors in borrower classification have been minimized using AI-based segmentation, leading to more stable repayment behavior among approved borrowers

Table 4

Default Rate Comparison

Model Type	Default Rate (Overall)	Thin-File Segment
Traditional Model	6.8%	11.2%
AI-Based Model	6.1%	8.4%

This decrease in default rates among the thin-file segment implies that the AI risk assessment system is successfully identifying creditworthy borrowers who would otherwise be denied access to credit.

4.3 Predictive model performance

Machine learning models perform better than logistic regression benchmarks in terms of accuracy and risk classification metrics.Gradient boosting and random forest models exhibit the strongest predictive model performance with improved Area Under the Curve (AUC) and F1-score values than traditional scoring methods.

Table 5

Model Performance Metrics

Model	**Accuracy**	**Precision**	**Recall**	**AUC**
Logistic Regression	72%	70%	68%	0.74
Random Forest	84%	82%	81%	0.88
Gradient Boosting	87%	85%	83%	0.91
Neural Network	85%	83%	80%	0.89

This is because the improved performance of the ensemble model is an indication that the model is effectively capturing the nonlinear nature of borrower characteristics and behavior. The improved performance is an indication of the improvement in inclusion outcomes while maintaining risk discipline.

4.4 Financial inclusion index improvement

To evaluate the improvement in financial inclusion, the authors develop the Financial Inclusion Expansion Index, which is measured as the proportion of new borrowers accessing formal debt financing. The index shows an improvement in financial inclusion as a result of the implementation of the AI model, especially among first-time borrowers and small enterprises.

The improvement in the number of new borrowers accessing formal debt financing is an indication that the implementation of the AI model is contributing to the achievement of the objectives set in the country's Vision 2030, especially the objectives related to the contributions made by the SME sector to the country's GDP and the private sector's growth.

4.5 Alternative data contribution analysis

The feature importance analysis shows that the alternative data variables contribute to the improved performance of the model. The alternative data variables include digital transaction consistency, utility payment patterns, and mobile payment frequencies, among other variables. The analysis shows that the variables are important in the evaluation of the borrower, especially compared to the traditional income and collateral evaluation methods.

The analysis shows that the inclusion of alternative data in the model is the main factor driving the improvement in financial inclusion, especially in the expansion of the thin-file borrower market, which would have remained disadvantaged without the inclusion of the alternative data variables in the model.

4.6 Economic stability considerations

The stress testing results for moderate economic downturn scenarios also showed that AI-scored portfolios are just as resilient as traditional portfolios. The risk-adjusted pricing ensures that new borrowers are appropriately segmented based on repayment capacity.

The balance between inclusion and stability is crucial for sustainable credit expansion. The results indicate that the adoption of AI, coupled with a governance structure, is a means to enhance financial inclusion without sacrificing stability.

4.7 Discussion

The results have shown empirical proof that AI plays a significant role in improving financial inclusion for the debt markets in Saudi Arabia. The use of AI to reduce informational asymmetry and improve the predictive power of credit scoring models is a means to improve financial inclusion for previously underserved populations.

The results are consistent with global research that found that machine learning improves credit risk classification for lenders. The study is unique, however, as it contributes to the broader literature on AI and financial inclusion within the context of

the Saudi Vision 2030 initiative. The results indicate that AI can be a means to improve financial inclusion and, therefore, contribute to the national economic transformation strategy.

The results also indicate that AI adoption is coupled with a governance structure to ensure that AI is fair and transparent, especially for lending decisions.

5 POLICY AND MANAGERIAL IMPLICATIONS

The implications of the results obtained in the current study are far-reaching, especially in the context of the Saudi Arabian financial system, and the need to strategically use and apply the technology, keeping in view the need to develop an appropriate and well-structured governance system, along with the need to develop the appropriate financial objectives, has been underscored in the current study in the context of the evaluation and provision of the appropriate credit facilities through the use of the technology.

In the context of the policy implications, the implications obtained in the current study are far-reaching, especially considering the fact that the results obtained in the current study are in line with the objectives and requirements stipulated in the Saudi Vision 2030, especially in the context of the increased level of participation and involvement of the SME sector in the Saudi Arabian financial system, promotion and encouragement of the entrepreneurship culture, and development and growth of the private sector in the Saudi Arabian economy. The results obtained in the current study, which highlight the increased level and extent of the financial inclusion in the Saudi Arabian economy through the provision of the debt finance instruments to the underserved segments of the Saudi Arabian economy, are likely to promote the creation of jobs in the economy, and the policymakers in the country are expected to promote the adoption and application of the technology in the Saudi Arabian economy, keeping in view the need to create an appropriate environment in the country for the adoption and application of the technology, while protecting the rights of the borrowers in the economy.

From the perspective of the relevant and appropriate financial and banking authorities, the implications and results obtained in the current study are significant and important, especially in the context of the increased financial inclusion with the

application and adoption of the AI technology, as the technology is likely to promote the monitoring and evaluation of the financial risk, especially with the accurate classification and differentiation of the borrowers and the increased financial stability and security. The relevant and appropriate financial and banking authorities are likely to consider the implications and results obtained in the current study and develop an appropriate and conducive environment with the application and adoption of the AI technology, especially in the context of the increased financial inclusion and the financial stability and security.

From the managerial point of view, it is imperative for the financial institutions to integrate the AI technology with strategic inclusion objectives. From the findings, it is evident that AI-based scoring systems improve approval rates for thin-file borrowers without affecting default rates significantly. Managers should view AI technology as a vital tool to expand the market rather than a tool to improve productivity. Expanding the lending markets of the underserved population presents a fresh chance to produce revenues while developing the national economy. Financial institutions have to invest in quality data infrastructure to support the effective adoption of AI technology. Financial institutions have to develop data governance to promote accuracy, completeness, and currency. The accuracy of the predictions made by machine learning algorithms depends on the effectiveness of feature selection. It is important for organizations to develop internal analytical capabilities to enable AI technology adoption.

Training and change management have to be given equal weightage to enable effective AI technology adoption. Credit officers and risk managers have to understand AI technology to enable effective risk score interpretation. Hybrid decision systems use predictions made by machine learning algorithms and human judgment to enable accuracy and transparency. Hybrid decision systems avoid biases that result from over-automation.

Ethical issues have to be included in AI technology-based inclusion strategies. Financial institutions have to understand biases in machine learning models. Algorithmic fairness enables trust in machine learning models. Algorithmic fairness is important in building trust in machine learning models. Building trust is important in the digital financial landscape of Saudi Arabia. Building trust is imperative in financial sector modernization.

In addition, financial technology partnership has the potential to hasten financial inclusion in debt financing. This will be realized through the partnership between conventional banks and financial technology platforms. This partnership has the potential to hasten financial inclusion in debt financing. In conclusion, financial inclusion through AI technology has a number of advantages, especially when carried out within a framework that has been developed with proper governance and regulations. Financial sector development in Saudi Arabia will be realized through an expanded debt financing strategy. Financial lending through AI technology has more benefits than just an improvement in technology. Financial lending through AI technology has the potential to become an economic strategy for a better financial future in Saudi Arabia, a strategy that has been envisioned for Saudi Arabia to realize its economic transformation vision by 2030.

6 CONCLUSION AND FUTURE RESEARCH

The main aim of the present study was to investigate the potential of artificial intelligence (AI) in promoting financial inclusion and ensuring access to debt finance for individuals and small and medium-sized enterprises (SMEs) in Saudi Arabia, in line with the overall objectives set out in the Kingdom's Vision 2030 plan. The Kingdom is in the process of transitioning into a diversified and technology-driven economy, and as part of this, the improvement and increase of responsible access to finance for individuals and SMEs is an important policy agenda. The results obtained through the present study show that the application of AI in credit scoring and online finance can enhance the classification accuracy, reduce the problem of information asymmetry, and increase access to finance among underserved groups without the risk of default rising significantly.

The results obtained through the present study show that the application of machine learning techniques, such as ensemble methods, namely, the application of the gradient boosting and random forest techniques, enhances the classification accuracy compared to the application of traditional techniques, namely, the application of logistic regression. The results also show that the inclusion of alternative data sources, namely, the inclusion of digital transaction and behavior-based data, enhances the classification

accuracy and enables the inclusion of underserved groups, namely, the inclusion of individuals with no or little credit history. The most important part is that the results show that the inclusion of underserved groups does not increase the risk of default, and the rate remains the same or even reduces, indicating the sustainability of the application of AI in finance inclusion.

The results also show that the role of governance and regulations in the strategy of AI adoption and deployment is significant, and while there is an improvement in the accuracy of classification results using AI-based approaches, responsible AI deployment needs to be made in order to ensure that inclusive finance practices are fair and promote consumer trust. The use of a hybrid approach, where human judgment is incorporated, is significant in order to effectively integrate AI into a regulated environment. If one takes a more macro-economic view, the inclusion of AI in the Saudi Arabian economy would be able to contribute towards the achievement of the objectives outlined in the Saudi Vision 2030 strategy.

By facilitating the funding of SMEs and promoting entrepreneurship, thereby enhancing the development of the private sector, intelligent credit systems would be able to contribute towards the diversification of the Saudi Arabian economy, thereby creating job opportunities. As such, the use of AI in the Saudi Arabian economy would be considered a significant tool towards ensuring the development of the Saudi Arabian economy. While there are significant benefits and advantages associated with the use of AI in the Saudi Arabian economy, there are certain limitations and areas where further research would be required in order to conduct this study.

Firstly, the study would be able to use data obtained from fintech platform data and bank data in order to gain a better insight into the inclusion of AI in the Saudi Arabian economy. Secondly, the study would be able to use qualitative evaluation in order to gain a better understanding of the inclusion of AI in the Saudi Arabian economy. In conclusion, the use of artificial intelligence can be a significant tool in the promotion of inclusive debt finance in the Saudi Arabian economy. Therefore, the use of AI can promote the achievement of the objectives set out in the Saudi Vision 2030 strategy and contribute to the development of the Saudi Arabian economy.

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Authors' Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.