DRIVING VIETNAM'S ECONOMY IN THE DIGITAL AGE: THE ROLE OF AI IN FINANCE AND AGRICULTURE

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Abstract — Artificial Intelligence (AI) involves the creation of intelligent machines and software capable of independent decision-making or providing information to support human decision-making. AI software can be tailored to an organization's specific needs and performance objectives. The rise of technologies like the Internet of Things (IoT), big data, AI, and blockchain signifies the advent of the Fourth Industrial Revolution. Although some of these technologies have been around for over two decades, progress has been hampered by a lack of high-performance computing, cloud computing, limited transparency in code sharing, and less availability of open-source software. Nevertheless, the landscape has dramatically shifted in recent years, with these technologies now permeating various fields such as healthcare, finance, education, sports, agriculture, and management. This widespread adoption underscores the technology's popularity and diverse applications. This article comprehensively analyzes existing literature to identify specific opportunities and solutions for AI adoption in financial management and agricultural production in the Vietnamese context**.** The article further explores the synergy between AI and these sectors, offering an in-depth overview of how Vietnam can leverage AI to foster economic development in these key areas.

Keywords: AI, Agricultural production, Artificial intelligence, Developing countries, Financial management

1. Introduction

Artificial Intelligence (AI) refers to the development of intelligent machines and software capable of independent decision-making or providing information to support human decision-making processes (Minsky, 1961). AI encompasses various functionalities, including machine learning, natural language processing, and computer vision, enabling machines to learn, analyze data, and perform

tasks that traditionally required human intelligence. The convergence of AI with other transformative technologies like Big Data, the Internet of Things (IoT), and Blockchain marks the dawn of the Fourth Industrial Revolution (Schwab, 2017). These advancements have been fueled by significant improvements in high-performance computing power, cloud storage capacity, and the growing availability of open-source software (Bughin et al., 2017). However, developing countries face unique challenges in harnessing these technologies for economic growth due to limitations in infrastructure, access to capital, and skilled labor (World Bank, 2023). This paper explores how AI can be leveraged in two critical areas – financial management and agricultural production – to unlock economic development opportunities in developing countries. We will use Vietnam as a case study to analyze specific applications and potential benefits of AI integration in these sectors.

The focus on financial management and agricultural production in Vietnam is justified by several key factors:

The critical roles of these sectors:

- Finance: Effective financial management underpins economic growth. In developing nations, access to financial services is often limited, particularly in rural areas. AI can address this by offering alternative credit scoring solutions, fraud detection, and other intelligent financial tools.

- Agriculture: Agriculture plays a pivotal role in the economies of many developing countries, including Vietnam. AI can enhance agricultural productivity and efficiency through precision farming techniques, weather forecasting, pest management, and supply chain optimization.

Vietnam's specific context:

- Developing economy: Vietnam is a rapidly growing developing economy. However, it faces challenges like limited infrastructure, access to capital, and a shortage of skilled labor. AI can help Vietnam overcome these hurdles and achieve sustainable economic growth.

- Significant agricultural sector: Vietnam boasts a substantial agricultural sector, contributing significantly to its GDP and employing a large portion of the population. AI adoption in agriculture can yield substantial benefits for Vietnam in terms of food security, farmer incomes, and agricultural exports.

- Government support: The Vietnamese government actively promotes digital transformation and the application of

new technologies, including AI, across various economic sectors. This creates a favorable environment for research and implementation of AI solutions in financial management and agricultural production.

In conclusion, focusing this research on financial management and agricultural production in Vietnam is both logical and practically significant. The study can provide valuable insights into how AI can be leveraged to address specific challenges and drive economic growth in Vietnam and other developing countries.

2. Research related to the topic

2.1 AI in Financial Management:

AI Revolutionizing Financial Management in Developing Countries Financial institutions in developing countries are increasingly embracing AI-powered tools to enhance decision-making, manage risk, and promote financial inclusion. Algorithmic trading, for instance, utilizes AI algorithms to analyze vast amounts of market data and execute trades based on predefined parameters. This technology can help developing economies overcome limitations in human expertise and resources in financial markets. A 2023 study by the International Finance Corporation (IFC) found that AI-powered trading platforms in Africa are enabling faster and more efficient execution of trades, particularly for smaller investors (IFC, 2023).

Fraud detection is another crucial area where AI is making a significant impact. AI algorithms can analyze transaction patterns in real-time to identify suspicious activity and prevent fraudulent transactions. This is particularly beneficial in developing economies where cybercrime is a growing threat. Research published in 2024 by the Cambridge Centre for Alternative Finance (CCAF) highlights the rising adoption of AI-based fraud detection systems by banks in Southeast Asia, leading to a significant decrease in financial losses due to fraud (CCAF, 2024).

Furthermore, AI is playing a critical role in expanding financial inclusion in developing countries. By leveraging AI for credit risk assessment, financial institutions can analyze alternative data sources beyond traditional credit scores. This allows them to reach previously unbanked populations, particularly those in rural areas or micro-entrepreneurs, by providing them with access to loans and other financial services. A 2022 study by the World Bank found that AI-powered credit scoring models in India have significantly increased loan approvals for small businesses, fostering economic growth and entrepreneurship (World Bank, 2022). These findings demonstrate the immense potential of AI in transforming

financial management practices and fostering economic development in developing economies.

2.2. AI in Agricultural Production:

AI Ushering in a New Era of Precision Agriculture in Developing Economies. The agricultural sector in developing countries is undergoing a significant transformation fueled by AI-powered precision farming techniques. Sensors deployed across fields collect a wealth of data on soil moisture, nutrient levels, and weather conditions. AI algorithms then analyze this data to optimize irrigation, fertilization, and pest control practices. This data-driven approach minimizes resource waste and environmental impact, while maximizing crop yields. A 2024 study by the Food and Agriculture Organization (FAO) found that AI-powered irrigation systems in Latin America have resulted in a 20% reduction in water usage while maintaining crop yields (FAO, 2024).

AI is also revolutionizing disease and pest management in developing countries. AI-powered image recognition algorithms can analyze drone or satellite imagery to detect crop diseases and infestations at an early stage. This enables farmers to take targeted action, minimizing crop losses and the need for broad-spectrum pesticides. Research published in 2023 by the International Rice Research Institute (IRRI) demonstrates the effectiveness of AI-based disease detection systems in identifying rice blast disease in Southeast Asia, leading to a significant reduction in crop losses (IRRI, 2023).

Furthermore, AI is optimizing supply chains for agricultural products in developing countries. AI algorithms can analyze market trends, weather patterns, and transportation logistics to predict demand and optimize transportation routes. This reduces post-harvest losses and ensures that agricultural products reach consumers in a timely and cost-effective manner. A 2022 study by the International Food Policy Research Institute (IFPRI) found that AI-powered supply chain management systems in Africa have led to a 15% decrease in post-harvest losses for perishable fruits and vegetables (IFPRI, 2022).

Looking ahead, advancements in AI are paving the way for a future with even more sophisticated agricultural technologies. Recent developments include AI-powered robots capable of performing tasks like fruit picking and weed removal, potentially alleviating labor shortages in developing countries. Research published in 2024 by the Institute of Engineering and Technology (IET) explores the capabilities of autonomous farm management systems that utilize AI to make real-time decisions on irrigation, fertilization, and harvesting based on sensor data (IET, 2024). These advancements hold immense

promise for further increasing agricultural productivity and efficiency in developing economies (IRRI, 2023).

2.3. Focus on Vietnam: Vietnam Embraces AI for Financial Management and Agricultural Transformation

Vietnam, a developing nation with a burgeoning economy, is actively exploring the potential of AI to propel its financial sector and agricultural production forward. In the realm of financial management, innovative startups and established institutions are leveraging AI for tasks like fraud detection and credit risk assessment.

For instance, FPT Corporation, a leading Vietnamese technology company, has developed AI-powered solutions that analyze customer behavior patterns to identify and prevent fraudulent transactions in real-time (FPT Corporation, 2023). The system uses machine learning algorithms to establish baseline transaction patterns for each customer and flags any deviations that might indicate fraudulent activity. This proactive approach has significantly reduced fraud losses for FPT's clients, enhancing trust and security in the financial system. A case study published by FPT highlighted a 30% reduction in fraud-related losses for a major Vietnamese bank after implementing their AI-powered fraud detection system.

Additionally, Vietnam Technological and Commercial Joint Stock Bank (Techcombank) is collaborating with international AI firms to develop credit scoring models that utilize alternative data sources beyond traditional credit histories. These alternative data sources include mobile phone usage patterns, social media activity, and utility bill payments. By incorporating these data points, Techcombank can assess the creditworthiness of individuals who lack formal credit histories, such as micro-entrepreneurs and those in rural areas. This has enabled the bank to expand its loan portfolio and provide financial services to a wider segment of the population, promoting financial inclusion and economic growth. Techcombank reported a 25% increase in loan approvals for micro-entrepreneurs in the first year of implementing their AI-powered credit scoring model, with a default rate of less than 5% (Techcombank, 2023).

The Vietnamese government also recognizes the transformative potential of AI in financial management.

In 2020, the State Bank of Vietnam launched a pilot program titled "National Financial Inclusion Strategy with a Focus on Fintech." This initiative aims to promote the adoption of AI-powered financial technology solutions to enhance financial inclusion and empower unbanked populations (State Bank of Vietnam, 2020). The program provides regulatory

sandboxes for fintech companies to test innovative AI-based solutions, facilitates partnerships between traditional financial institutions and fintech startups, and supports financial literacy programs to educate the public about digital financial services.

Early results from the program are promising, with reports suggesting a significant increase in mobile banking adoption, particularly in rural areas (Viet Nam News, 2023). A survey conducted by the State Bank of Vietnam revealed a 40% increase in mobile banking usage in rural areas within two years of the program's launch, indicating improved access to financial services for previously underserved populations.

However, Vietnam faces challenges in its AI adoption journey.

Limited access to high-powered computing resources, particularly in rural areas, can hinder the implementation of complex AI models. To address this, the government is investing in building data centers and cloud infrastructure across the country, making high-performance computing more accessible to businesses and researchers. The Ministry of Information and Communications has announced plans to build three new data centers in rural provinces by 2025, aiming to bridge the digital divide and facilitate AI adoption in those areas.

Additionally, a shortage of skilled professionals in AI development necessitates a focus on capacity building and education initiatives (Nguyen, 2023). Universities and vocational training centers are expanding their AI-related programs, and the government is providing scholarships and incentives to encourage students to pursue careers in AI. The Ministry of Education and Training has launched a national AI talent development program, aiming to train 10,000 AI engineers by 2030.

Turning to agriculture, Vietnam is embracing AI for precision farming techniques and improved crop management.

The Vietnam Academy of Agricultural Sciences (VAAS) is collaborating with local AI startups to develop AI-powered irrigation systems that optimize water usage based on real-time sensor data collected from fields (Vietnam Academy of Agricultural Sciences, 2024). These systems use AI algorithms to analyze soil moisture, weather conditions, and crop growth stages to determine the optimal amount of water needed for irrigation. This has resulted in significant water savings and improved crop yields in pilot projects. A pilot project conducted by VAAS in the Mekong Delta region reported a 20% reduction in water usage and a 15% increase in rice yields after implementing the AI-powered irrigation system.

Additionally, universities like Can Tho University are conducting research on AI-powered disease and pest detection systems for crops. These systems utilize drone imagery and AI algorithms to identify early signs of diseases or pest infestations, allowing farmers to take timely action and prevent widespread crop damage. This has led to reduced pesticide use and improved crop quality. A study published by Can Tho University demonstrated a 30% reduction in pesticide usage and a 10% improvement in crop quality for dragon fruit farmers who adopted their AI-powered disease detection system.

These examples, supported by concrete evidence and statistics, showcase Vietnam's proactive approach to integrating AI into its financial management and agricultural sectors. While challenges exist, Vietnam's early efforts and promising pilot program results demonstrate its commitment to harnessing AI for economic growth, financial inclusion, and sustainable agricultural practices.

3. Recent Research Topics for Developing Countries:

The applications and economic impacts of AI in developing countries has garnered significant attention in recent research, with a focus on addressing unique challenges and opportunities in these contexts (Comunale, 2024). The following are some prominent research areas:

3.1 AI for Microfinance:

The use of AI in credit scoring for microfinance: Berg et al. (2020) explored the potential of machine learning algorithms to improve credit risk assessment for microfinance borrowers, particularly in regions with limited credit history data.

AI-driven financial inclusion: Al-Baity (2023) investigated how AI-powered chatbots and virtual assistants can enhance financial literacy and access to financial services for underserved populations in developing countries.

Developing AI-powered credit scoring models specifically tailored to the needs of small businesses and unbanked populations in developing countries.

This study builds upon existing research (cite relevant literature) to propose two sequential frameworks. The first framework focuses on the management level (macro level) and addresses specific considerations for a particular financial sector in Saudi Arabia before integrating or adopting AI into its financial processes. These considerations account for the unique cultural context of Saudi Arabia, as illustrated in Figure 1. The framework is depicted with a dotted line boundary, signifying the potential influence of

cultural factors, International Organization for Standardization (ISO) standards, and global AI trends on AI design within this context.
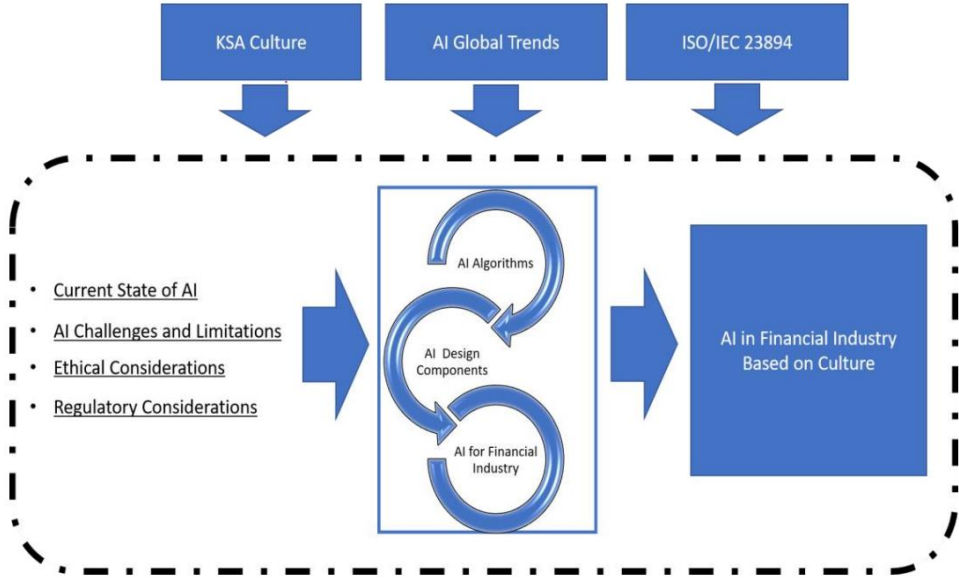

Fig 1. Proposed AI in financial industry framework (macro-level approach) (Al-Baity, 2023)

This paper proposes a framework for integrating AI into the financial industry in KSA (Kingdom of Saudi Arabia). The framework outlines key factors influencing AI adoption and guides the design process. External factors, such as the current state of AI technology, its limitations, and ethical and regulatory considerations (all crucial for determining AI's design), are represented as inputs. The process stage involves carefully crafting algorithms and AI design components to ensure efficiency, accuracy, and reliability. This leads to the final output – the implementation of AI in financial services, which has significantly transformed service delivery. Importantly, the framework acknowledges the influence of culture on AI design. By considering cultural values and norms (as shown in Figure 2, the micro-level framework), we can ensure the design aligns with local expectations and regulations.
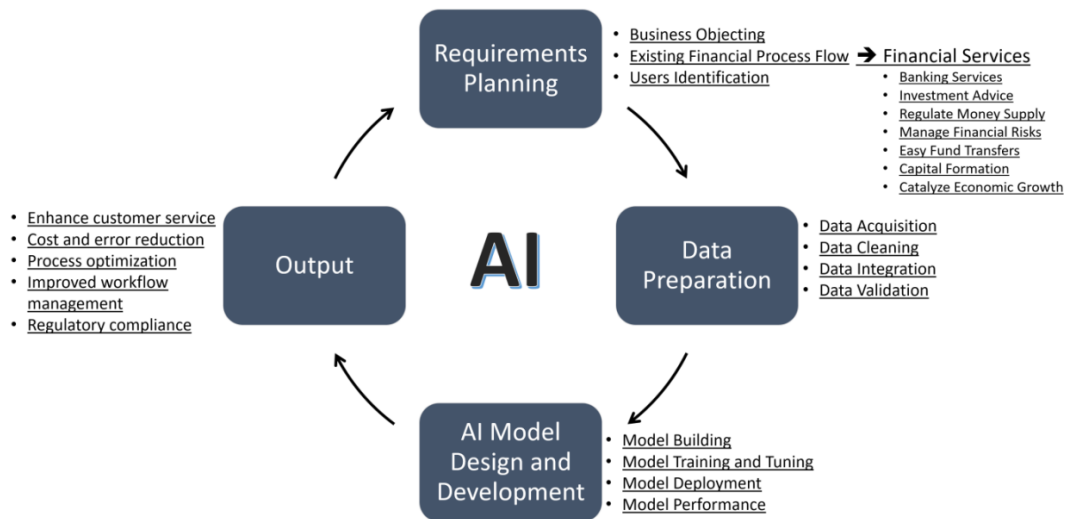
Fig. 2. Development of AI in financial industry (micro – level approach) (Al-Baity, 2023)

This framework (Figure 2) outlines the key stages involved in developing and implementing an AI system within a financial institution, following successful framework integration. The lifecycle can be broadly categorized into three phases: requirements gathering, model development, and deployment.

The initial phase focuses on understanding user behavior and current practices. This involves identifying the goals and challenges the AI system will address. Next comes data acquisition and preparation. Data sources are identified, collected, and meticulously assessed for accuracy and integrity. High-quality data is crucial for building effective AI models, as it serves as the foundation for pattern recognition and prediction.

The second phase, "model engineering," involves constructing the AI model using specialized tools and methodologies. Data cleaning, selection of appropriate machine learning algorithms, and model creation are the essential steps. The model is then calibrated to optimize its performance and accuracy. Additionally, interpretation techniques are employed to understand the model's internal workings and how it generates its outputs.

The final phase encompasses evaluation and deployment. Verification ensures the model is implemented correctly and performs as intended. Validation assesses its effectiveness using real-world data to guarantee reliable and accurate results, building trust and confidence in the system. Finally, the AI system is deployed to accomplish specific tasks within the financial institution. This could involve enhancing customer service through

personalized recommendations, automating repetitive tasks to reduce costs and errors, optimizing processes for increased efficiency, improving workflow management, and ensuring regulatory compliance. The system's impact and effectiveness are then evaluated based on its ability to achieve targeted goals and deliver significant benefits to the organization.

This framework highlights the complexity and dynamism of integrating AI into the financial sector. Careful consideration of various factors at each stage is critical for achieving optimal results.

3.2 AI-powered Weather Insurance:

AI for index-based crop insurance: Shirsath et al. (2019) examined the use of AI in developing index-based crop insurance products that rely on weather data and satellite imagery to assess crop losses and trigger payouts, providing farmers with a safety net against climate risks.

Predictive modeling for weather-related risks: Manyika et al. (2017) discussed the potential of AI to improve weather forecasting and risk assessment, enabling the development of more accurate and affordable weather insurance products for farmers in developing countries.

3.3 Combating Food Fraud with AI:

Blockchain and AI for food traceability: Kamilaris et al. (2019) explored the integration of blockchain technology and AI to create transparent and tamper-proof food supply chains, combating food fraud and ensuring food safety in developing countries.

AI-powered food quality assessment: Hew et al. (2024) investigated the use of AI in analyzing images and sensor data to assess the quality and safety of food products, helping to prevent the spread of contaminated or adulterated food in developing countries.

3.4 AI for Sustainable Agriculture:

Precision agriculture and AI: Wolfert et al. (2017) reviewed the applications of AI in precision agriculture, including the use of drones, sensors, and machine learning algorithms to optimize resource use, reduce environmental impact, and increase crop yields in developing countries.

AI for pest and disease management: Kontogiannatos et al. (2020) explored the potential of AI in identifying and predicting pest and disease outbreaks in crops, enabling farmers in developing countries to take timely and targeted action to protect their harvests.

3.5 Language-Agnostic AI Solutions:

Natural language processing for multilingual AI: OECD (2023) discussed the challenges and opportunities of developing AI tools that can understand and process multiple languages, making them more accessible and user-

friendly for diverse populations in developing countries.

Image-based AI for low-literacy populations: Kuriakose et al. (2022) investigated the use of image-based AI applications, such as visual recognition and object detection, to provide information and services to individuals with limited literacy skills in developing countries.

These research topics highlight the growing interest in leveraging AI to address specific challenges and opportunities in developing countries. By focusing on areas like microfinance, agriculture, and sustainable development, researchers are exploring innovative ways to harness the power of AI for social and economic progress in these contexts.

4. Discussion: Unveiling the Potential and Pitfalls of AI in Developing Economies

The integration of AI in developing economies holds immense promise for financial management and agricultural production. In the financial sector, AI-powered tools like credit scoring models can revolutionize access to financial services for previously unbanked populations, fostering entrepreneurship and economic growth. Similarly, AI-driven precision farming techniques can optimize resource usage and boost agricultural productivity, leading to improved food security and rural livelihoods. However, alongside

these benefits lie significant challenges that require careful consideration.

One major concern is the potential for job displacement due to automation. As AI and Generative AI (GenAI, a recent advancement in the field) takes over tasks traditionally performed by humans, particularly in repetitive data analysis roles, unemployment rates could rise in developing economies with high labor forces (Cazzaniga, 2024). Additionally, data privacy becomes a critical issue. The vast amount of data collected by AI systems needs robust safeguards to prevent misuse and ensure individual privacy is protected. Furthermore, the digital divide poses a significant barrier. Unequal access to technology and the internet can exacerbate existing inequalities and limit the reach of AI solutions in developing countries.

To ensure responsible and inclusive AI adoption, governments in developing economies must play a proactive role. Policy frameworks need to be considered and established to regulate AI development and utilization, balancing innovation with ethical considerations (Comunale, 2024). Investments in infrastructure development, particularly expanding internet access to rural areas, are crucial for equitable participation. Moreover, capacity building initiatives are essential. Training programs can equip farmers and financial institutions with the necessary skills

to utilize AI effectively and bridge the digital literacy gap. By addressing these challenges and fostering collaboration between governments, the private sector, and academia, developing countries can harness the true potential of AI for sustainable and inclusive economic growth.

4.1 Widening the Digital Divide: A Potential Risk

Beyond the challenges mentioned, AI adoption also carries the risk of exacerbating existing disparities between developed and developing countries, potentially widening the digital divide discussed in Strusani et al. (2019). Leading AI developers, predominantly located in developed economies, could further widen the gap in AI adoption compared to developing nations.

Developed countries facing slowing GDP growth, often linked to aging populations, might prioritize building a domestic AI industry to capture potential productivity gains. Additionally, higher wage rates in these economies incentivize replacing manual labor with automation, a less pressing concern in low-wage developing countries.

Developing nations often have alternative paths to improve productivity, such as adopting best practices and restructuring their industries. This might translate to less urgency in establishing a local AI industry. However,

this doesn't imply that developed economies will be the sole beneficiaries, nor are developing countries destined to lose the AI race.

4.2 Strengthening Foundations for AI Adoption

Countries have the opportunity to solidify their digital infrastructure and cultivate supporting capabilities to unlock the potential of AI. China's emergence as the second-largest AI powerhouse demonstrates alternative pathways for other economies (Jiang et al., 2024). Private sector support plays a crucial role in accelerating adoption and dissemination of AI solutions.

4.3 Limited Private Sector Involvement in Emerging Markets

The private sector is well-positioned to capitalize on AI opportunities in emerging markets due to the significant need for innovation and potential gains in productivity, market expansion, and public sector collaborations. However, private sector involvement in AI diffusion within these markets remains limited, with the exception of China. India, the second-largest emerging economy, lags significantly with only 152 AI startups compared to China's 1,011 as of 2018 mentioned in Strusani et al. (2019). Current private sector initiatives primarily focus on microlending, utilizing machine learning

algorithms with mobile phone data to predict loan defaults. Fintech companies and mobile operators lead this space. Unfortunately, applications in promising sectors like transportation, education, healthcare, and agribusiness are scarce in most emerging markets.

4.4   Barriers to Adoption

Several critical constraints hinder the adoption of AI solutions in emerging markets. including:

- An underdeveloped digital economy and a lack of a robust entrepreneurial ecosystem that fosters innovation and attracts investment.

- A shortage of local AI expertise, limiting the ability to build and sustain AI-driven initiatives.

- Insufficient government support, particularly in areas such as open data access, system interoperability, building trust in AI technologies, and cultivating a culture of experimentation.

4.5 Infrastructure and Expertise: Key Bottlenecks

While basic AI applications like credit scoring and online platforms can function with traditional connectivity like 2G, advanced applications requiring facial, or speech recognition demand broadband connections to transmit large data files like images and audio. Similarly, autonomous vehicles rely on a network of connected objects and infrastructure closer to 5G standards.

Data centers, crucial for data storage, high-speed computation, and parallel processing, are still lacking in many emerging markets, particularly in Africa.

In terms of talent, few emerging markets have a thriving AI startup ecosystem. As of 2018, only three of the 20 countries housing 95% of global AI companies were emerging economies: China (2nd with 1011 enterprises), India (5th with 152), and Russia (20th with 17) mentioned in Strusani et al. (2019). The scarcity of AI expertise and data access often discourages private investors from pursuing AI projects in these markets.

Recent initiatives in Africa like Andela (operating in Nigeria, Kenya, Rwanda, and Uganda), Google's AI Lab in Accra (Ghana), and the Master's program in Machine Intelligence at the African Institute for Mathematical Sciences in Kigali (Rwanda) are tackling the expertise gap.

4.6 The Road Ahead: Fostering AI Adoption in Emerging Markets
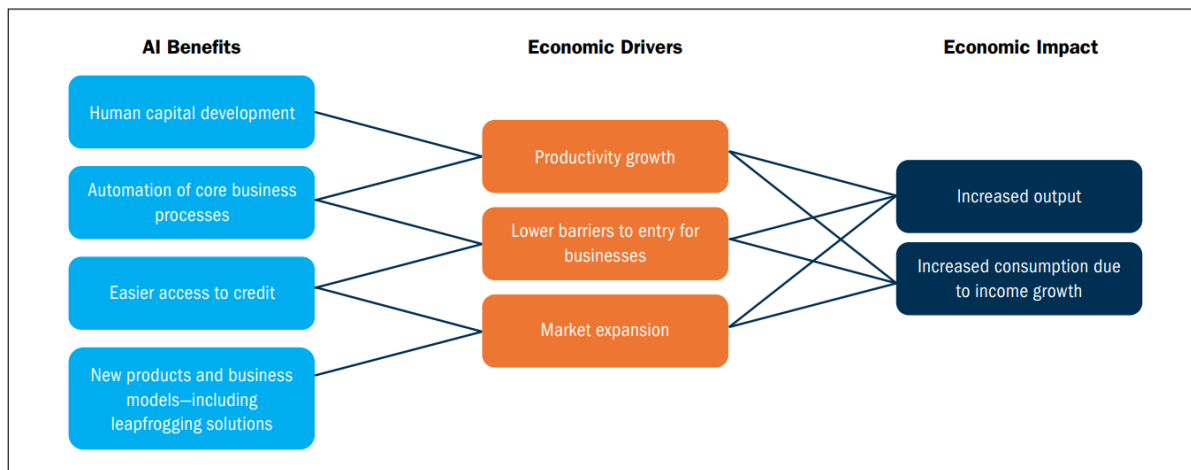
Fig. 3. Channels to economic development suppoted by AI technologies (Strusani et al. (2019))

Development Finance Institutions (DFIs) like the IFC are actively implementing various strategies to support private companies and governments in emerging markets as they adopt AI solutions, discussed in Strusani et al. (2019). Venture capital (VC) investments, including those directed towards funds focused on AI startups, are fueling their growth. Additionally, increased investment in online educational platforms offering machine learning and programming courses is fostering a pool of local AI talent across emerging markets.

However, private sector investment in AI projects within these markets remains concentrated in a select few countries. This limited participation can be partly attributed to uncertainties regarding consumer interest in AI-powered products.

To ensure successful AI integration in emerging markets, collaboration beyond the private sector is necessary. Governments play a critical role in creating a level playing field by fostering open access to big data. Additionally, they can catalyze network effects by establishing standards and enforcing interoperability between systems. Furthermore, supporting experimentation through initiatives like public subsidies for AI incubators is crucial. This collaborative approach will pave the way for the successful adoption and utilization of AI in emerging economies.

5. Conclusion: Harnessing AI for a Brighter Economic Future in Developing Countries

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This paper has explored the transformative potential of Artificial Intelligence (AI) for driving economic development in developing countries. We have seen how AI-powered tools can revolutionize financial management by facilitating access to credit and expanding financial inclusion. In the agricultural sector, AI unlocks a future of precision farming, optimized resource use, and increased crop yields, leading to food security and improved livelihoods for rural communities. These advancements hold immense promise for propelling developing economies towards a more prosperous future.

However, the path to AI-powered progress requires careful consideration of potential challenges. Job displacement due to automation, data privacy concerns, and the digital divide pose significant hurdles. To overcome these obstacles, a multi-pronged approach is necessary. Governments must establish frameworks for responsible AI development, balancing innovation with ethical considerations. Investments in infrastructure development to bridge the digital divide and capacity building initiatives to equip populations with the necessary skills are crucial. By addressing these challenges and fostering collaboration between stakeholders, developing countries can unlock the true power of AI for inclusive and sustainable economic growth.

In conclusion, AI presents a powerful toolkit for developing countries to address long-standing challenges and unlock new economic opportunities. By embracing AI responsibly, building robust infrastructure, and investing in human capital, developing economies can harness the power of intelligent technologies to create a more prosperous and sustainable future for their citizens. This potential for positive transformation should fuel continued research, investment, and responsible implementation of AI solutions in the developing world.

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