

## Digital Transformation and the Informal Economy: A Comparative Analysis with Focus on Algeria

التحول الرقمي والاقتصاد غير الرسمي: تحليل مقارنة مع التركيز على الجزائر

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### Abstract:

This study examines how digital transformation can formalize Algeria's informal economy, contributing to economic growth and policy efficiency. Utilizing a literature review, content analysis, and comparative analysis of global best practices, such as India's Aadhaar system and Kenya's M-Pesa, the study identifies strategies that can be adapted to the Algerian context. The study concludes that digital technologies offer a multifaceted approach to bridging the gap between formal and informal sectors by improving market access, financial transparency, and service delivery. Policy recommendations emphasize developing a national digital strategy, enhancing infrastructure, simplifying regulations, and promoting digital literacy to effectively reduce informality and promote sustainable socio-economic development.

**Keywords:** Digital transformation, Informal economy, Algeria, Economic formalization, Financial inclusion.

**Jel Classification Codes:** O33, O17.

### الملخص:

تبحث هذه الدراسة في كيفية مساهمة التحول الرقمي في هيكلية الاقتصاد غير الرسمي في الجزائر، مما يعزز النمو الاقتصادي وكفاءة السياسات. من خلال مراجعة الأدبيات والتحليل المحتوى والتحليل المقارن لأفضل الممارسات العالمية، مثل نظام "أدهار" في الهند و"إم-بيسا" في كينيا، تحدد الدراسة الاستراتيجيات التي يمكن تكييفها مع السياق الجزائري. وتستنتج الدراسة أن التقنيات الرقمية تقدم نهجا متعدد الجوانب لسد الفجوة بين القطاعين الرسمي وغير الرسمي، من خلال تحسين الوصول إلى الأسواق، وتعزيز الشفافية المالية، وتحسين تقديم الخدمات. وتشمل التوصيات السياسية تطوير استراتيجية رقمية وطنية، وتعزيز البنية التحتية، وتبسيط القوانين، وتعزيز محور الأمية الرقمية، بهدف الحد من الاقتصاد غير الرسمي وتعزيز التنمية الاجتماعية والاقتصادية المستدامة.

الكلمات المفتاحية: التحول الرقمي، الاقتصاد غير الرسمي، الجزائر، هيكلية الاقتصاد، الشمول المالي.

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## **1. Introduction**

Digital transformation is increasingly influencing global economies, reshaping business operations, governance, and service delivery. Rapid advancements in technologies like artificial intelligence, the Internet of Things (IoT), and mobile communication are driving this shift, contributing to broader economic development, particularly in developing countries (Hoekman, 2021; Stojanovska-Stefanova et al., 2020). Digitization has the potential to foster economic diversification and efficiency, promoting e-governance and entrepreneurial growth (Ozor, 2020). However, in many regions, including the Arab world, the pace of digital transformation remains slow due to infrastructural and policy challenges (Madani et al., 2021). In Algeria, the informal economy presents specific challenges, characterized by unregistered businesses, cash-based transactions, and employment that operates outside legal frameworks (Seddi, 2021). This pervasive informality limits tax revenue, social protection, and economic productivity, underscoring the need for digital strategies to formalize informal activities by enhancing transparency, access to markets, and financial inclusion (Hoekman, 2021). Several studies have explored the nexus of digitization and informal economies. For instance, Hoekman (2021) and Adonu (2020) discussed how digitalization can support the growth of MSMEs and economic diversification in the Arab world, including Algeria. Kum (2024) and Gutierrez-Romero (2007) have examined the impact of informal economies on income inequality and socio-economic development, highlighting the role of digital financial inclusion and e-Government in formalization (Ahmedov, 2020; Coetzer, 2022). Successful global models, such as India's Aadhaar system and Kenya's M-Pesa, provide examples of how digitization can enhance financial inclusion and service delivery (Kum, 2024; Mbiti & Weil, 2016).

This study aims to analyze the role of digital transformation in formalizing Algeria's informal economy through content analysis and literature review. It seeks to address the primary question:

***How can global best practices in digital transformation be adapted to effectively formalize and reduce the size of the informal economy in Algeria?***

To answer this, the research explores several supporting questions:

*Which countries have successfully leveraged digital transformation policies to formalize their informal economies, and what lessons can be drawn from their experiences?*

*What challenges did these countries encounter during the digital transformation process, and what strategies were employed to overcome them?*

*What are the key factors necessary for successfully adapting and implementing these digital transformation policies within the Algerian context?*

*How can digital transformation be strategically utilized to integrate and formalize informal economic activities within Algeria's broader economic framework?*

By drawing on comparative insights, this study will highlight successful models that can be tailored to Algeria's unique context. This research is significant as it explores the intersection of digital transformation and economic formalization, contributing to the broader literature on digital economies and providing practical insights into socio-economic development.

## **2. Literature Review**

Digitization is the process of converting analog information into digital form, which serves as the foundation for broader digitalization and digital transformation, reshaping business operations, governance, and economic activities globally.

### **2.1. Definitions and Theoretical Perspectives on Digitization**

Digitization, as described by Hoekman (2021), refers to the conversion of information into a digital format using technologies that transform business processes and governance mechanisms. Beyond the mere technical aspect of converting analog data to digital, this process involves enhancing business operations and services, contributing to a broader digital transformation across industries (Hoekman, 2021). This comprehensive transformation is driven by rapid advancements in areas such as artificial intelligence, data analytics, the Internet of Things (IoT), and mobile communication, which together facilitate the growth of the digital economy.

In the context of developing countries, digitalization has been closely linked to e-Government efforts aimed at improving transparency, efficiency, and public participation. Stojanovska-Stefanova et al. (2020) emphasize that e-Government entails not only the adoption of information and communication technologies (ICT) by government entities but also a fundamental reorganization of structures and processes to optimize service delivery to both citizens and businesses. The significance of e-Government became particularly evident during the COVID-19 pandemic, where remote access to government services became essential.

The terms "digitization," "digitalization," and "digital transformation" represent a progression of technological and organizational changes:

- **Digitization:** The conversion of analog information into a digital format to facilitate easier processing, storage, and transmission.
- **Digitalization:** The application of digital technologies to existing processes, improving efficiency and enabling new forms of service delivery.
- **Digital Transformation:** The development of new business models, products, and socio-economic interactions enabled by digital technologies.

Hoekman (2021) further suggests that digitization has led to the "servicification" of economies, where services become central to economic activities across various sectors. This trend is more prominent in middle-income countries, where services now constitute a larger share of the GDP. However, in regions such as the Arab world, economic transformation through digitization has been relatively slow, indicating an area that requires policy intervention and improvement (Madani et al., 2021).

In Africa, digitalization extends its influence to higher education, science, technology, and innovation (HESTI). According to Ozor (2020), digital technologies are crucial for fostering entrepreneurship and aligning skills training with industry needs. Moreover, the African Development Bank highlights the necessity of equipping higher education institutions with digital infrastructure to enhance employability and entrepreneurial activities.

The case of Algeria exemplifies the challenges associated with digital transformation. Seddi (2021) points out that Algeria, with its reliance on oil and gas, experiences economic challenges that necessitate structural

reforms and diversification. The country's economic difficulties underline the importance of digitalization as a strategy for adapting to global economic shifts.

In conclusion, the expansion of the digital economy significantly influences economic activities and policy considerations globally. Successful digitalization strategies and leadership are crucial for promoting economic growth, competitiveness, and enhanced service delivery in both public and private sectors.

## **2.2. Definitions and Theoretical Perspectives on the Informal Economy**

The informal economy comprises economic activities that operate outside formal regulatory and legal frameworks, often characterized by unregistered businesses, cash-based transactions, and employment without legal protections, varying significantly across countries and regions.

- **Defining the Informal Economy:** The informal economy consists of activities that operate outside of the formal regulatory and legal framework. It is characterized by economic transactions that are not officially recorded, which may include street vendors, unregistered businesses, and informal labor markets. The informal sector's size and significance vary significantly across countries and regions. Feld and Schneider (2010) define the informal economy as comprising any economic activities not officially part of the formal sector but which contribute to the gross domestic product (GDP).
- **Drivers of the Informal Economy:** The drivers of informality can be multifaceted. According to Medina and Schneider (2021), factors such as tax and social security burdens, institutional quality (e.g., corruption), regulations, public sector services, tax morale, official economy development, self-employment, size of the agricultural sector, cash usage, labor force structure, and economic growth play crucial roles in influencing the size and dynamics of the informal economy. There is no universally agreed-upon definition or quantification method for the informal economy, leading to variations in understanding and measurement.
- **The Impact on Socio-Economic Development:** The informal economy has both positive and negative impacts on socio-economic development. While it can provide livelihoods and reduce poverty for

some, it often lacks legal protections, social benefits, and contributes to income inequality. Research shows that the informal sector may exacerbate income inequality, as seen in BRICS countries (Brazil, Russia, India, China, and South Africa) where a 1% increase in the informal economy correlates with a 3.24% rise in the GINI coefficient (Kum, 2024). Studies have found that wealth disparity often leads to larger informal economies (Gutierrez-Romero, 2007), and higher poverty levels are associated with increased informality (Mishra & Ray, 2010).

Countries with larger informal economies often experience challenges in income redistribution and economic equality. For instance, Rosser et al. (2000) found a positive relationship between income inequality and the size of the informal sector in developing countries, suggesting that the existence and growth of the informal economy can contribute to heightened income inequality.

- **Policy Considerations and Governmental Interventions:** Governments have employed various redistributive programs and policies to address informality, including progressive taxation and social welfare programs. However, the effectiveness of these policies in reducing inequality and poverty associated with informal sectors has shown mixed results. In economies with substantial informal sectors, enforcement and compliance challenges further complicate the implementation of formal regulatory measures (Loucif, 2023; Soumya, 2023). This reflects the need for nuanced and adaptable approaches to policymaking that can more effectively integrate informal economic activities into the formal economy.
- **Informal Economy in Digital Transformation and Policy Implications:** Digital transformation, particularly as examined in the Arab world by Hoekman (2021), presents opportunities for economic diversification and the enhancement of trade. Digitalization can significantly impact the informal sector by providing better access to market platforms and supporting the growth of MSMEs (Micro, Small, and Medium Enterprises) (Adonu, 2020). However, the ability to leverage these opportunities is highly dependent on the existence of supportive institutional and regulatory frameworks that facilitate access to digital technologies. Such frameworks have the potential to impact the informal economy positively by fostering formal employment opportunities, enhancing access to markets, and supporting entrepreneurship (Ahmedov, 2020; Hadj, 2023). This underscores the importance of policy interventions that are tailored to create conducive environments for the digital economy, which can indirectly contribute to the formalization of informal economic activities.

### **3. Conceptual Framework**

Conceptual models link digital transformation to economic formalization by illustrating how digital tools and platforms enhance financial inclusion, streamline e-governance, and promote market access, thus facilitating the integration of informal activities into the formal economy.

#### **3.1. Conceptual Models Linking Digital Transformation to Economic Formalization**

Digital transformation can facilitate the formalization of informal economic activities through several conceptual models:

- **Digital Financial Inclusion Model:** Digitization enhances financial inclusion by providing digital financial services to unbanked individuals and businesses, notably through mobile banking, digital payments, and online credit services. Kenya's M-Pesa system exemplifies how digital platforms can bring informal workers and businesses into the formal financial system by promoting transparency and traceability (Loucif, 2023; Hadj, 2023; Adonu, 2020).
- **E-Governance and Digital Public Services Model:** E-governance, which utilizes digital technologies in public administration, streamlines formalization by reducing administrative costs associated with formal business operations. Estonia's e-governance system demonstrates how digitized public services enhance transparency and efficiency, encouraging economic formalization (Ahmedov, 2020; Kum, 2024).
- **Market Access and Digital Entrepreneurship Model:** Digital platforms and e-commerce allow small-scale businesses to access larger markets and cross-border trade, reducing operational costs and incentivizing formalization to gain access to financial services and government support mechanisms (Hoekman, 2021; Coetzer, 2022).
- **Digital Data and Transparency Model:** The digitalization of economic transactions enhances transparency, enabling governments to monitor activities, improve tax collection, and enforce regulations effectively. India's Aadhaar system is an example of how digital identities can facilitate transparent distribution of government benefits (Kum, 2024; Madani et al., 2021).
- **Network and Ecosystem Model:** Digital ecosystems encourage businesses to formalize to maximize network benefits. Participation in

these ecosystems often requires compliance with formal regulations, creating a feedback loop that promotes economic formalization (Cahyadi & Magda, 2021; Mbiti & Weil, 2016).

### **3.2. Challenges and Opportunities of Digitization in Relation to Formalization**

Despite the potential benefits of digital transformation, challenges include:

- **Digital Infrastructure and Access:** Success depends on equitable access to reliable internet, digital devices, and literacy (Hoekman, 2021; Coetzer, 2022).
- **Regulatory and Policy Barriers:** Restrictive regulations can limit the adoption of digital tools, highlighting the need for policies that support digital activities in the informal sector (Madani et al., 2021).
- **Socio-Cultural Factors:** Resistance to change and cultural norms favoring cash transactions can hinder the adoption of digital platforms (Kum, 2024; Orozco et al., 2023).

To realize successful formalization, policy, infrastructure, and capacity-building efforts must align, particularly in countries like Algeria, which faces its own set of challenges on its path to digital transformation (Loucif, 2023; Hoekman, 2021; Soumya, 2023).

## **4. Global Digitization Initiatives**

Several countries have successfully implemented digitization initiatives that have transformed their economies and reduced informality, including India's Aadhaar system for digital identity, Kenya's M-Pesa mobile banking platform, Estonia's comprehensive e-Governance system, and Brazil's PIX payment system, each offering unique approaches to enhancing financial inclusion, governance, and access to digital services.

### **4.1. India: Aadhaar Digital Identity System**

India's Aadhaar system is recognized as one of the world's largest and most successful biometric-based digital identity systems. Launched in 2009, Aadhaar assigns a unique 12-digit identification number to residents of India, which is linked to their biometric and demographic data (Kum, 2024). As a policy initiative, Aadhaar aims to provide every resident with

a digital identity that can be authenticated for accessing government services, financial systems, and other social welfare schemes.

The Aadhaar system has contributed significantly to enhancing transparency and efficiency in the delivery of government services, reducing identity fraud, and promoting financial inclusion. It serves as a foundational ID for multiple public and private services, enabling the government to directly transfer subsidies and benefits to individuals. This digitalization effort has reduced leakages in public distribution systems and improved the overall efficiency of service delivery.

## **4.2. Kenya: M-Pesa Mobile Banking System**

Kenya's M-Pesa is a landmark initiative in the field of mobile money and digital financial services. Launched by Vodafone and Safaricom in 2007, M-Pesa was designed to provide an easy and secure method of transferring money through mobile phones (Kum, 2024). Over the years, it has evolved into a comprehensive mobile banking system, allowing users to not only transfer money but also make payments, save, and access credit services.

M-Pesa has significantly contributed to financial inclusion, especially for the unbanked population in Kenya. It leverages the high penetration of mobile phones and has become an essential tool for both individual users and small businesses. The system's success is attributed to its simplicity, low-cost transactions, and the wide network of agents facilitating money transfers and payments. M-Pesa's model has been widely replicated across other countries, showing its global impact on digital financial services.

## **4.3. Estonia: e-Governance**

Estonia is often hailed as a pioneer of e-governance, with its digital transformation journey beginning in the early 2000s. The Estonian government implemented a series of digital initiatives aimed at creating a paperless society where public services could be accessed online, efficiently and securely (Hoekman, 2021). The foundation of Estonia's e-governance model is the e-Residency program, a digital ID that allows access to government services, secure online transactions, and business operations globally.

This digitization effort has enabled nearly all public services, such as health, education, and taxation, to be conducted online. Estonia's interoperability framework, called X-Road, connects various databases and services securely, ensuring the seamless exchange of data between public and private sectors. The country has managed to save substantial resources through reduced paperwork, improved service efficiency, and minimized bureaucracy.

#### **4.4. Brazil: PIX Payment System**

In 2020, Brazil launched the PIX instant payment system, which transformed the country's financial landscape. PIX is managed by the Central Bank of Brazil and allows for instant money transfers, 24/7, across different financial institutions without any fees for individuals (Hoekman, 2021). The system's design focuses on interoperability, facilitating seamless transactions between banks and other financial service providers.

PIX's impact has been profound in promoting financial inclusion, improving payment speed, and lowering transaction costs. It has been rapidly adopted across the country, even by small businesses and informal sector workers, due to its ease of use and no-cost feature for individual users. PIX also reduces the reliance on cash transactions, supporting the broader goal of digital financial systems. The success of PIX has set a benchmark for other countries aiming to improve their digital payment ecosystems.

Estonia's e-governance model and Brazil's PIX payment system are examples of how countries can effectively implement digital policies to leverage technology for economic development, improved service delivery, and financial inclusion. These case studies complement other successful global digital initiatives such as India's Aadhaar system, which integrates digital identities for efficient service delivery, and Kenya's M-Pesa mobile banking platform, which has expanded financial services to underserved communities (Mbiti & Weil, 2016). Together, these initiatives demonstrate that digitalization, when coupled with supportive policy frameworks and government commitment, can drive socio-economic growth and enhance the accessibility and efficiency of public and private services across different contexts.

### **5. The Context of Algeria: Challenges and Opportunities**

Algeria's economic landscape presents a unique set of challenges and opportunities for digital transformation, particularly in addressing its substantial informal sector. The potential of digitization to formalize economic activities offers a pathway for economic growth, improved transparency, and enhanced access to financial services, but requires a comprehensive understanding of the local context and strategic policy implementation.

## **5.1. Overview of the Algerian Economy and Informal Sector Characteristics**

Algeria, like many economies in the Middle East and North Africa (MENA) region, has faced significant challenges associated with the informal sector. The informal economy comprises economic activities that are not regulated by the government, often characterized by small-scale businesses, unregistered workers, and cash-based transactions. As highlighted in studies of the BRICS countries, the informal economy can have profound impacts on socio-economic development, influencing income distribution and often perpetuating inequality (Kum, 2024). While specific studies on Algeria are less frequently covered in the literature, it can be inferred that similar dynamics exist due to the widespread nature of informal economic activity in the MENA region.

According to the Economic Research Forum's (ERF) working paper by Hoekman (2021), the Arab world, including Algeria, has witnessed only a modest increase in the share of services in GDP relative to other middle-income countries. In Algeria, this slower growth in the services sector could be partially attributed to the presence of a significant informal economy that is not captured in official statistics, leading to discrepancies in economic development indicators.

- **Characteristics of the Informal Sector in Algeria:** The informal sector in Algeria, like in other MENA countries, provides employment opportunities, particularly in segments of the population that have limited access to formal job markets. However, informal employment often lacks social protection, stable income, and access to credit and business services, which can hinder long-term economic growth and development. The informal economy typically emerges due to various factors, including high unemployment rates, complex regulations for starting and running businesses, and limited access to formal financial institutions.

## **5.2. Current State of Digitization Efforts in Algeria**

Algeria's digitization efforts are underway but face challenges due to infrastructural gaps, regulatory barriers, and low digital readiness.

- **Current State of Algeria's Informal Economy and Digital Readiness:** The informal economy in Algeria represents a significant portion of its overall economic activity, much like other economies in the Middle East and North Africa (MENA) region. Informality in Algeria is characterized by unregistered businesses, cash-based transactions, and employment that does not comply with legal or regulatory frameworks. The high level of informality contributes to various challenges, including reduced tax revenue, limited social protections for workers, and inefficiencies in economic productivity. As Hoekman (2021) highlights in the context of the broader MENA region, the informal sector can undermine economic growth and development by restricting access to credit and investment, and by limiting the government's ability to implement policies effectively.

Digital readiness in Algeria is evolving but faces several barriers. A key challenge is the need for improved digital infrastructure, such as stable internet connectivity and access to digital devices, which are prerequisites for leveraging digital technologies effectively (Hoekman, 2021). The government has initiated policies aimed at enhancing digital transformation, particularly in public administration and service delivery. However, the progress in developing a comprehensive digital ecosystem that integrates the informal sector into the formal economy remains limited. There is a need to develop policies and initiatives that specifically address the challenges of informality by enabling financial inclusion, fostering digital literacy, and creating conducive regulatory frameworks that encourage informal businesses to transition to formal operations.

- **Digitization Efforts in Algeria:** Digitization in Algeria is an emerging area of focus, with the potential to address some of the challenges associated with the informal sector. However, Algeria faces several hurdles in its digitization efforts, including infrastructural gaps, regulatory constraints, and the need to foster a digital business environment that can support small enterprises and entrepreneurs.

The ERF working paper (Hoekman, 2021) points out that successful digital transformation in the region, including in Algeria, is contingent on developing a comprehensive policy framework that promotes access to digital technologies and encourages the integration of businesses into the

digital economy. This framework would ideally address challenges such as regulatory barriers, insufficient infrastructure, and the need to enhance digital literacy and entrepreneurship skills among Algerian MSMEs (Micro, Small, and Medium Enterprises).

- **Current Digitization Policies and Initiatives:** In recent years, the Algerian government has initiated policies aimed at promoting digital transformation. These include efforts to modernize administrative procedures, enhance e-governance, and improve digital infrastructure to facilitate access to online services for both citizens and businesses. Such policies aim to promote greater financial inclusion, improve access to markets, and integrate informal businesses into the formal economy through digital tools and platforms.

Nonetheless, these digitization efforts remain at an early stage compared to some other MENA, which have more advanced e-governance systems and digital economies. There is also a need to focus on building trust in digital systems, enhancing cybersecurity, and creating a regulatory environment that supports e-commerce and cross-border digital trade.

- **Challenges in Digitizing the Informal Sector:** Despite the potential of digitization to formalize the informal economy in Algeria, several key challenges remain:

- **Digital Infrastructure and Access:** A major barrier to widespread digitization is the lack of reliable internet connectivity, access to affordable digital devices, and comprehensive digital infrastructure. These issues make it difficult for informal businesses to access and benefit from digital technologies, thereby hindering their integration into the formal sector (Hoekman, 2021).
- **Regulatory and Policy Environment:** Algeria requires a more supportive policy framework to facilitate digital transactions and encourage the formal registration of businesses. Regulatory reforms could streamline the process for informal businesses to become formalized, thereby enabling them to take advantage of digital platforms and financial services (Madani et al., 2021).
- **Digital Literacy and Skills:** There is a pressing need for capacity-building initiatives to enhance digital literacy and skills among entrepreneurs and informal workers. Ensuring that these individuals can effectively use digital tools is critical for business growth, improved market access, and full participation in the formal economy.

In summary, while Algeria has begun to embrace digitization to address the challenges of the informal sector, there is a significant need for further infrastructural development, regulatory reform, and digital capacity building to realize the full benefits of a digital economy and promote the transition from informality to formality.

- **Opportunities for Digitization to Address Informality:** Digitization in Algeria offers significant opportunities to bring informal businesses into the formal economy by reducing the cost of business registration, enabling easier access to financial services, and providing platforms for market access. E-governance initiatives can improve transparency, reduce corruption, and streamline administrative processes, making it easier for individuals and businesses to comply with regulations and formalize their operations.

Moreover, digital payment systems can help reduce reliance on cash transactions, making it easier to track economic activities and ensuring that businesses and workers benefit from formal protections and access to credit. This can facilitate economic growth and reduce the risks associated with operating in the informal sector.

While Algeria has made some strides towards digitization, there is significant potential to further develop policies and infrastructure to support digital transformation and reduce the size of the informal economy. Overcoming challenges related to infrastructure, regulatory frameworks, and digital literacy will be crucial for the successful implementation of digitization policies and the integration of informal businesses into the formal economic sector.

## **6. Comparative Insights and Policy Recommendations**

The digital transformation journey of Algeria can be significantly improved by learning from the successful digitization initiatives of countries like Kenya, India, Estonia, and Brazil. These case studies provide a roadmap for how Algeria might enhance its informal economy and improve its overall digital readiness.

### **6.1. Learning from Global Case Studies**

Algeria's efforts to integrate the informal economy into the formal sector can benefit from examining global case studies, which serve as practical models for various aspects of digital transformation:

- **Adopting Mobile Payment Systems like M-Pesa (Kenya):** Kenya's M-Pesa has revolutionized financial inclusion by offering secure, low-cost mobile transactions. This has greatly impacted informal businesses and individuals who previously lacked access to formal banking (Adonu, 2020). Algeria could similarly benefit by developing mobile banking platforms that cater to the unbanked population and informal sector workers. The high reliance on cash transactions in Algeria highlights the need for such systems, which would not only increase financial transparency and credit access but also encourage businesses to formalize.
- **Implementing Digital Identity Frameworks like Aadhaar (India):** India's Aadhaar system is a large-scale digital identity framework that leverages biometric identification to enhance governance, service delivery, and financial inclusion (Kum, 2024). For Algeria, implementing a similar approach could streamline access to government benefits, improve transparency, and ease business registration and tax compliance. Such a comprehensive digital identity system would not only improve service efficiency but also help bring informal economic activities into the formal fold by providing secure and efficient access to essential services.
- **E-Governance Lessons from Estonia's Digital Public Services:** Estonia's e-governance model has been a global leader, demonstrating how digitizing public services reduces corruption, improves efficiency, and encourages formalization (Hoekman, 2021). The Estonian government's success lies in creating a seamless digital ecosystem where nearly all public services are available online. Algeria can take inspiration from Estonia by digitizing administrative processes like tax filing, business registration, and public benefits access, which can reduce bureaucratic costs and help integrate informal businesses into the formal economy.
- **The Role of Digital Payment Systems, Inspired by Brazil's PIX:** Brazil's PIX system is a transformative model for instant, cost-free digital payments, which has greatly reduced reliance on cash (Hoekman, 2021). Algeria can replicate this model by establishing a similarly user-friendly payment system to enable efficient transactions, enhance financial transparency, and support a cashless economy. A PIX-like infrastructure would facilitate efficient digital transactions, improve oversight of

economic activities, and offer a secure platform for informal businesses to transition to formal operations.

## **6.2. Policy Recommendations for Algeria**

Drawing from these global insights, Algeria's approach to digital transformation must be comprehensive and adapted to its local context. Below are key recommendations to support this journey:

- **Comprehensive Digital Strategy:** Algeria needs a unified national digital strategy that aligns with its socio-economic goals, promoting digital transformation across sectors such as finance, education, health, and governance. As the African Development Bank notes, a well-crafted digital strategy would contribute to diversifying the economy, addressing its heavy reliance on oil and gas, and improving economic resilience (Seddi, 2021).
- **Digital Infrastructure Enhancement:** Building robust and equitable digital infrastructure is essential for effective digital transformation (Hoekman, 2021). Algeria should focus on expanding access to affordable, high-speed internet, especially in rural areas, and ensuring the availability of digital devices to facilitate access to online services. Digital infrastructure forms the backbone of financial inclusion and access to e-governance platforms, making it a priority for the country's development.
- **Regulatory Reforms and Simplification:** Algeria's current regulatory environment is characterized by complexity and bureaucratic inefficiencies, which impede the adoption of digital tools (Loucif, 2023). Streamlining regulations is critical to support the growth of e-commerce, secure digital transactions, and efficient business registration. Clear, supportive policies around data privacy and digital transactions will help build trust in digital systems and encourage the formalization of informal businesses.
- **Promoting Financial Inclusion through Digital Payments:** Developing secure, accessible, and cost-effective digital payment systems is crucial for expanding financial inclusion in Algeria (Adonu, 2020). Partnering with telecom providers and fintech companies to offer user-friendly platforms can encourage the adoption of digital payments among informal workers and businesses. Such financial inclusion initiatives can significantly reduce cash dependency, increase access to credit, and facilitate the formalization of economic activities.

- **Capacity Building and Digital Literacy Initiatives:** Improving digital literacy is key to ensuring that the benefits of digital transformation reach all segments of the population (Tiour, Koridjidj, & Hadj, 2024). National training programs should focus on enhancing digital skills, targeting informal sector workers, small business owners, and marginalized groups. Enhanced digital literacy will empower people to utilize digital platforms effectively, fostering a culture of innovation and entrepreneurship.
- **Fostering Public-Private Partnerships:** To accelerate digital transformation, public-private collaboration is essential. Governments, telecom companies, financial institutions, and technology firms should work together to develop digital infrastructure, promote financial inclusion, and support capacity-building initiatives. This multi-stakeholder approach will help create a sustainable and inclusive digital ecosystem (Loucif, 2023).

### **6.3. The Role of Stakeholders**

A successful digital transformation in Algeria requires the coordinated efforts of key stakeholders, each playing a distinct yet complementary role:

- **Government: Policy-Making, Infrastructure Investment, and Digital Services Promotion**

The government's primary role is to create a conducive environment for digital transformation through supportive policies, regulatory reforms, and infrastructure investment (Soumya, 2023). Furthermore, by digitizing its own services (e.g., social benefits, tax filing), the government sets a precedent for digital adoption and builds public trust in the formal economy.

- **Private Sector: Telecom, Banking, and Fintech Contributions to Digital Ecosystem Development**

The private sector is critical in developing and delivering digital solutions for financial services, telecommunications, and e-commerce. By partnering with the government, the private sector can contribute to building robust digital platforms that are secure, user-friendly, and promote financial inclusion. For instance, fintech companies can play a significant role in developing digital payment systems that cater to the needs of the informal sector (Adonu, 2020).

- **Civil Society: Raising Awareness, Supporting Inclusive Policies, and Training for Digital Literacy**

Civil society organizations can play a vital role in raising awareness about the benefits of digital technologies, advocating for inclusive policies, and offering training to improve digital literacy and trust in digital platforms Tiour et al (2024). By reaching out to marginalized and vulnerable groups, civil society can ensure that no one is left behind in the country's digital transformation journey.

## **7. Challenges for Implementing Digitization in Algeria**

While the aforementioned recommendations hold significant potential, implementing such policies in Algeria faces unique challenges, such as infrastructural, regulatory, socio-cultural, and financial constraints:

### **7.1. Digital Infrastructure Gaps**

Algeria currently faces limitations in access to reliable, high-speed internet and affordable digital devices, especially in rural areas (Hoekman, 2021). Bridging this infrastructure gap is critical to ensuring equitable access to digital services and platforms. Enhanced digital connectivity would enable informal businesses to access digital financial services, online markets, and e-governance, which are essential for economic inclusion.

### **7.2. Hurdles and Bureaucratic Inefficiencies**

Algeria's complex regulatory environment and bureaucratic inefficiencies hinder digital adoption (Loucif, 2023). There is a pressing need for clear and comprehensive policies that support digital activities, facilitate online business registration, and protect data privacy. Addressing these regulatory barriers will be key to fostering innovation, promoting digital commerce, and encouraging the formalization of businesses.

### **7.3. Low Financial Inclusion and Limited Digital Payment Systems**

A significant portion of Algeria's population, especially in the informal sector, lacks access to formal banking and financial services, impeding the adoption of digital payment systems (Adonu, 2020). Financial literacy

initiatives and partnerships with telecom providers are essential to promote digital payments and financial inclusion. Policies that incentivize digital financial tools could help overcome the dependence on cash-based transactions and provide secure, user-friendly payment solutions.

#### **7.4. Digital Literacy and Socio-Cultural Barriers**

Limited digital literacy and a preference for cash-based transactions present socio-cultural barriers to the adoption of digital platforms Tiour et al (2024). Addressing these challenges requires public awareness campaigns, training programs, and efforts to build trust in digital systems. Resistance to change, concerns over cybersecurity, and the perceived complexity of digital technologies need to be overcome to support broad-based digital adoption.

#### **7.5. Cybersecurity and Data Privacy Concerns**

Concerns over data privacy and cybersecurity can undermine public trust in digital systems. Algeria must develop robust policies for data protection and digital identity management to ensure secure online transactions and build confidence in the digital economy (Kum, 2024). Developing a legal framework that protects user data and minimizes cybersecurity risks is crucial for fostering digital inclusion and encouraging the use of digital platforms.

By learning from global best practices and addressing local challenges through targeted policy interventions, Algeria can enhance its digital transformation efforts, integrate the informal sector into the formal economy, and drive sustainable economic growth. A coordinated effort involving the government, private sector, and civil society will be key to building an inclusive digital ecosystem that maximizes economic opportunities for all. This transformation would not only improve financial inclusion but also facilitate access to markets, services, and governance for Algeria's population.

### **8. Conclusion**

The increasing influence of digital transformation on global economies presents both opportunities and challenges, particularly for developing countries . The adoption of digital technologies such as artificial

intelligence, mobile communications, and the Internet of Things (IoT) has the potential to reshape business operations, governance, and service delivery. In regions where the informal economy is widespread, like Algeria, digital transformation presents a particularly attractive opportunity, providing a strategic approach to bringing economic activities currently outside the legal framework into the formal sector. However, this transition requires adapting global best practices to the specific cultural, infrastructural, and policy contexts of Algeria. This study critically analyzes how digital transformation can be harnessed to formalize the informal economy in Algeria, drawing on global best practices and examining both the challenges and opportunities unique to the Algerian context. The findings underscore that digital technologies have a multifaceted role in addressing informality by improving market access, enhancing financial inclusion, and increasing transparency. However, for Algeria to effectively implement these digital strategies, it is crucial to address several challenges, such as infrastructure deficits, regulatory complexities, and limited digital literacy, which currently hinder the seamless adoption and integration of digital solutions into the informal economy. The following are the key results derived from the study:

- Digital technologies can bridge the gap between formal and informal sectors, offering platforms for transparent business registration, access to markets, and financial services;
- The study identifies successful digital initiatives from countries like India (Aadhaar), Kenya (M-Pesa), Estonia (e-Governance), and Brazil (PIX) that have successfully addressed informality and financial inclusion, which can be adapted for the Algerian context;
- Key obstacles such as limited digital infrastructure, regulatory complexity, socio-cultural resistance, and gaps in digital literacy must be addressed to enable the full potential of digital transformation;
- A supportive policy environment is crucial for facilitating digital adoption in informal sectors. It requires comprehensive strategies to encourage financial inclusion, reduce cash-based transactions, and create efficient administrative processes.

To maximize the impact of digital transformation in formalizing Algeria's informal economy, the following clarifications and recommendations are proposed:

- **Develop a Unified National Digital Strategy:** Algeria should create a cohesive digital strategy that aligns with socio-economic goals, focusing on expanding access to digital infrastructure, particularly in rural and underserved areas;
- **Enhance Regulatory Reforms for Digital Inclusion:** Simplify business registration processes and ensure the regulatory framework supports digital transactions, data privacy, and the secure use of e-commerce platforms;
- **Promote Digital Literacy and Capacity Building:** Implement national programs aimed at improving digital skills among entrepreneurs, small business owners, and informal workers to ensure equitable access to the benefits of digitalization;
- **Encourage Public-Private Partnerships:** Foster collaboration between government, telecom providers, financial institutions, and technology companies to build a sustainable digital ecosystem that supports financial inclusion and the formalization of economic activities;
- **Implement Secure and Cost-effective Digital Payment Systems:** Develop and promote user-friendly digital payment platforms to facilitate financial transactions, reduce reliance on cash, and provide secure avenues for informal businesses to engage with formal financial services.

In conclusion, the strategic deployment of digital transformation has the potential to significantly reduce the size of Algeria's informal economy and promote sustainable socio-economic development. By adapting successful global models and addressing local challenges, Algeria can build a digital infrastructure that fosters economic growth, financial inclusion, and efficient governance. This alignment of digital transformation with formalization goals would not only benefit the Algerian economy but also provide a framework for other developing nations seeking to leverage digital technologies for economic formalization and inclusivity.

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