

The Impact of Information and Communication Technology on FinTech Development: Evidence from WAEMU Countries

Berkane Imed^{1,*}, Hammadi Zoubida² & Mattoug Djamel³

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Abstract: Background: Information and communication technology (ICT) has become a fundamental driver of digital transformation and the expansion of financial technology (FinTech), particularly in developing regions such as the West African Economic and Monetary Union (WAEMU). While electronic money services have experienced significant growth, disparities in ICT goods imports across member states may constrain the full potential of FinTech in promoting financial inclusion. **Aim:** This study seeks to examine the impact of ICT on FinTech development in selected WAEMU countries over the period 2012–2023. **Method:** Panel data econometric techniques were employed using EViews 13 software. The analysis focused on six WAEMU countries—Côte d'Ivoire, Benin, Burkina Faso, Niger, Senegal, and Togo—excluding Mali and Guinea-Bissau due to data unavailability. CT goods imports were proxied by ICT goods imports as a percentage of total merchandise imports, while FinTech adoption was measured by the usage rate of electronic money services, with data sourced from the World Bank and the Central Bank of West African States (BCEAO). **Results:** The random effects model revealed a positive and statistically significant relationship between CT goods imports and FinTech adoption. Specifically, a one-unit increase in ICT goods imports was associated with a 8.97-unit rise in the electronic money usage index at the 1% significance level. These findings underscore the role of CT goods imports in fostering digital wallets, mobile payments, and digital banking services, thereby contributing to financial inclusion, although the effect varies across countries depending on infrastructure quality and regulatory frameworks. **Conclusion:** The study demonstrates that sustained CT goods imports is essential for accelerating FinTech development and strengthening financial inclusion in WAEMU. Policymakers are advised to prioritize CT goods imports, enhance digital infrastructure, establish secure regulatory frameworks, and foster regional cooperation to maximize the benefits of financial technology and achieve deeper financial integration in the digital era.

Keywords: ICT, Fintech, imports of ICT goods, electronic money services, WAEMU.

تأثير تكنولوجيا المعلومات والاتصالات على تطوير التكنولوجيا المالية: أدلة من دول الاتحاد الاقتصادي والنقدي لغرب أفريقيا

بركان عماد^{1,*}، وحمادي زبيدة²، ومعتوق جمال³

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المخلص: خلفية البحث: تُعد تكنولوجيا المعلومات والاتصال (ICT) أحد المحركات الأساسية لتطوير التكنولوجيا المالية (FinTech) وتعزيز الشمول المالي، لا سيما في الدول النامية. وفي إطار الاتحاد الاقتصادي والنقدي لغرب إفريقيا (WAEMU)، شهدت خدمات النقود الإلكترونية توسعاً ملحوظاً، غير أن التباينات في واردات تكنولوجيا المعلومات والاتصال والبنية التحتية الرقمية قد تُقيّد من تحقيق كامل إمكاناتها. **الهدف:** يهدف هذا البحث إلى دراسة أثر تكنولوجيا المعلومات والاتصال على تطور التكنولوجيا المالية في بعض دول WAEMU خلال الفترة (2012–2023)، مع التركيز على دور واردات سلع تكنولوجيا المعلومات والاتصال في دعم الخدمات المالية الرقمية وتعزيز الشمول المالي. **المنهجية:** تم اعتماد تقنيات بيانات البانل باستخدام برنامج EViews 13. وشملت العينة ست دول أعضاء في WAEMU وهي: ساحل العاج، بنين، بوركينا فاسو، النيجر، السنغال، وتوغو، في حين تم استبعاد مالي وغينيا-بيساو لغياب البيانات. وقد تم قياس تطور تكنولوجيا المعلومات والاتصال من خلال واردات سلعتها كنسبة من إجمالي الواردات السلعية، بينما تم قياس اعتماد التكنولوجيا المالية بمؤشر استخدام خدمات النقود الإلكترونية، اعتماداً على بيانات البنك الدولي والبنك المركزي لدول غرب إفريقيا (BCEAO). **النتائج:** أظهرت تقديرات نموذج التأثيرات العشوائية وجود علاقة إيجابية ودالة إحصائياً بين واردات سلع تكنولوجيا المعلومات والاتصال واعتماد التكنولوجيا المالية. إذ تبين أن زيادة وحدة واحدة في واردات سلع ICT تؤدي إلى ارتفاع مؤشر استخدام النقود الإلكترونية بمقدار 8.97 وحدة، عند مستوى دلالة 1%. **الخلاصة:** تؤكد النتائج على الدور المحوري لواردات سلع ICT في تعزيز المحافظ الرقمية، وخدمات الدفع عبر الهاتف المحمول، والخدمات المصرفية الإلكترونية في دول WAEMU. ويوصى صانعو السياسات بضرورة الاستمرار في الاستثمار في تكنولوجيا المعلومات والاتصال، وتطوير البنية التحتية الرقمية، وتعزيز الأطر التنظيمية، وتشجيع التعاون الإقليمي لتعظيم مكاسب التكنولوجيا المالية وتحقيق اندماج مالي أعمق في العصر الرقمي.

الكلمات المفتاحية: تكنولوجيا المعلومات والاتصالات، التكنولوجيا المالية، واردات سلع تكنولوجيا المعلومات والاتصالات، خدمات النقود الإلكترونية، الاتحاد الاقتصادي والنقدي لغرب إفريقيا.

1 Department of Management Science, Faculty of Economics, Business, and Management Sciences, Abbes Laghrour University – Khenchela, Algeria, Orcid: <https://orcid.org/0009-0009-3343-4327>

* Corresponding author: imed.berkane@univ-khenchela.dz

2 Department of Economics, Faculty of Economics, Business, and Management Sciences, Abbes Laghrour University – Khenchela, Algeria. Zoubidahammadi07@gmail.com

3 Department of Management Science, Faculty of Economics, Business, and Management Sciences, University of Constantine 2 – Abdelhamid Mehri, Algeria. djamel.mattoug@univ-constantine2.dz

1 قسم علوم التسيير، كلية العلوم الاقتصادية والتجارية وعلوم التسيير، جامعة عباس لغرور خنشلة، الجزائر

* الباحث المراسل: imed.berkane@univ-khenchela.dz

2 قسم العلوم الاقتصادية، كلية العلوم الاقتصادية والتجارية وعلوم التسيير، جامعة عباس لغرور خنشلة، الجزائر. Zoubidahammadi07@gmail.com

3 قسم علوم التسيير، كلية العلوم الاقتصادية والتجارية وعلوم التسيير، جامعة قسنطينة 2 – عبد الحميد مهري، الجزائر. djamel.mattoug@univ-constantine2.dz

Introduction

Information and communication technology (ICT) has emerged as a critical driver of economic growth and sectoral efficiency, playing a pivotal role in facilitating the flow of information, enhancing productivity, and strengthening competitiveness across diverse industries. The expansion of communication networks, widespread adoption of smartphones, and integration of digital solutions have fundamentally transformed national economic infrastructures. ICT not only improves service quality and reduces operational costs but also promotes inclusiveness, particularly in sectors inherently reliant on digital innovation, such as finance. Consequently, the development of ICT—through the expansion of internet connectivity, the importation of digital equipment, and the reinforcement of cybersecurity systems—has become an essential prerequisite for aligning with global digital transformations and supporting sustainable economic development.

Within this framework, financial technology (FinTech) represents one of the most significant manifestations of technological progress, reshaping financial service delivery through faster, more secure electronic payment systems and innovative digital platforms that enhance the operational efficiency of traditional banking institutions. By digitizing financial transactions, FinTech has expanded access to previously underserved populations, thereby reinforcing financial inclusion. Nevertheless, the effectiveness and adoption of FinTech are intrinsically dependent on the maturity of the underlying technological infrastructure, as electronic payment systems, digital wallets, and money transfer platforms require an advanced technical environment to operate efficiently and achieve broad penetration.

The interdependence between ICT development and FinTech adoption is therefore evident: robust ICT infrastructure underpins the deployment and widespread use of digital financial services, while facilitating their scalability and inclusiveness. This nexus is particularly pertinent in the context of the West African Economic and Monetary Union (WAEMU), where ICT development—reflected in ICT goods imports and digital infrastructure—and the diffusion of digital financial services exhibit considerable heterogeneity across member states. Such variability provides a unique opportunity to examine the dynamics of this relationship, offering insights into how technological capacity shapes the adoption of FinTech and contributes to financial inclusion and economic transformation within these economies.

Based on the above, the following main research question can be posed: ***"To what extent does ICT goods imports affect financial technology in the West African Economic and Monetary Union (WAEMU) countries under study during the period (2011–2023)?"***

As an initial response to this main question, the following main hypothesis can be formulated: ***There is no statistically significant effect of ICT goods imports on financial technology in the West African Economic and Monetary Union (WAEMU) countries under study during the period (2011–2023).***

This study is significant for examining the relationship between information and communication technology (ICT) and financial technology (FinTech), as digital infrastructure is crucial for financial innovation and the efficiency of digital transactions. Amid the global shift toward a digital economy, understanding the impact of ICT development on digital financial service adoption is especially important in developing countries with limited traditional financial infrastructure.

The study aims to:

- Define key concepts related to ICT and FinTech;
- Highlight ICT's role in enhancing FinTech adoption;
- Assess the impact of ICT goods imports on electronic money usage in WAEMU countries (2011–2023);
- Analyze the economic relationship between ICT development (proxied by ICT imports) and FinTech adoption (proxied by electronic money usage);
- Provide policy recommendations to strengthen ICT and financial inclusion in the region.

Methodologically, the study employs a descriptive-analytical approach, supplemented by case study analysis, and relies on econometric and statistical techniques to examine the ICT–FinTech nexus.

Background Literature

This section of the study is devoted to highlighting the most important theoretical aspects related to information and communication technology and financial technology, in addition to the relationship between them.

Information and Communication Technology

Information and communication technology (ICT) has contributed to a profound transformation in the business environment by reducing costs, creating opportunities, and providing greater convenience. It has enabled highly automated business processes and driven the emergence of big data, allowing organizations to convert vast amounts of information generated by ICT into strategic insights that foster the development of new products and services (Al-Badour, 2021). Consequently, ICT constitutes a fundamental pillar of contemporary economic and digital

developments, playing a crucial role in enhancing productivity, improving operational efficiency, and supporting innovation and sustainable growth. The following is a review of its concept, components, and reasons for adoption in it.

The Concept of Information and Communication Technology: Several definitions have addressed the concept of information and communication technology (ICT), which can be classified into three main directions according to the perspective used in determining its nature and role in the digital environment.

First, the device-based definition, where Yakini (2014) defines it as "a set of technical components that include computers, software, wired and wireless communication networks, workstations, robots, and smart chips, in addition to digital systems used in processing and exchanging information. This definition focuses on the physical infrastructure that forms the foundation of digital technology."

Second, the activity-based definition, which focuses on the core functions of information and communication technology (ICT), such as data processing, storage, transfer, transmission, display, and management. According to this perspective, "Information and communication technology is not limited to devices only, but also includes the processes that enable the transformation of data into usable digital information." (Farghali, 2007)

Third, the comprehensive definition that combines devices, activities, and the human element, where Salman (2009) considers information and communication technology to represent "a fusion between microelectronics, computers, and modern communication media, and it includes not only tools and systems but also the users who contribute to the circulation and processing of information in an automated and effective way."

Based on this, information and communication technology can be defined as an integrated system that includes digital devices, software systems, and communication infrastructure, in addition to the processes and activities that enable the effective processing, storage, transfer, and retrieval of data. It is not limited to technical tools only, but also includes human interaction and the ability to employ this technology in various economic and social fields.

Components of Information and Communication Technology: ICT comprises several interrelated components that facilitate data processing, information storage, and communication between individuals and institutions (Al Khanaq, 2016):

- **Hardware:** Physical infrastructure including computers, servers, storage devices, input/output devices, and networking equipment.
- **Software:** Programs and applications that control device operations, including operating systems, application software, and security/networking tools.
- **Networks and Communication:** Systems enabling data exchange, such as LAN, WAN, the Internet, Wi-Fi, Bluetooth, and fiber-optic communications.
- **Data and Information:** Raw data (numbers, texts, images) and processed information stored in databases for decision-making.
- **Processes and Procedures:** Rules and steps for operating ICT systems, from data input to processing and output generation.
- **People:** Users, programmers, analysts, network engineers, and administrators who operate, maintain, and develop ICT systems to achieve organizational objectives.

Reasons for ICT Development and Adoption: The expansion of ICT is driven by several factors (Boucetta & Sahal, 2022):

- **Environmental disruption and organizational complexity:** Technological, political, and economic changes compel organizations to adopt ICT to enhance efficiency and adaptability.
- **Intensification of competition:** ICT improves productivity, quality, and profitability, enabling firms to compete globally.
- **Labor market transformations:** ICT facilitates workforce integration, including women, people with disabilities, and longer-working populations, by improving coordination and communication.
- **Rising consumer awareness:** ICT enhances customer experience and supports fast, efficient interaction between institutions and consumers.
- **Technological innovation acceleration:** ICT drives digital progress, reshapes business environments, and promotes economic growth through continuous innovation in products and services.

Financial Technology

With the rapid development of digital technologies, financial technology (FinTech) has become a fundamental element in modernizing the financial sector, providing innovative solutions that enhance the efficiency of financial operations. The following is a review of its concept, requirements, and products.

The Concept of Financial Technology (FinTech): Following the 2008 financial crisis, declining trust in traditional banks drove demand for more flexible and personalized financial solutions, fueling rapid FinTech growth (Anyfantaki, 2016). Startups in major hubs such as London, Silicon Valley, and New York, and later in emerging economies, leveraged digital technologies and smartphones to provide efficient financial services to unbanked populations. FinTech encompasses

companies integrating financial services with modern technologies, offering digital products that emphasize ease of use, efficiency, transparency, and automation. Beyond banking, FinTech also includes insurance, financial instruments, and software solutions, enhancing market efficiency and supporting digital transformation in the financial sector (Dorfleitner et al., 2016).

Requirements of Financial Technology: Sustainable growth in FinTech relies on several key technologies:

- Artificial Intelligence: Enables machines to perform human-like tasks through learning, reasoning, and decision-making (CLÉMENÇON, 2018).
- Internet of Things: Connects devices and systems via sensors to monitor, process data, make decisions, and communicate efficiently (Hoa & Kim, 2021).
- Cloud Computing: Provides on-demand access to shared computing resources, including networks, servers, storage, and applications (Clohessy et al., 2017).
- Big Data: Large, diverse datasets requiring advanced analytics and storage, offering

actionable insights (Brunelle & Brunelle , 2019).

- Blockchain: Decentralized, encrypted ledger for recording financial transactions, contracts, and asset trading without third-party verification (Al-Khair, 2020).
- Cybersecurity: Technologies, processes, and practices that protect networks, systems, software, and data from attacks or unauthorized access, ensuring confidentiality, integrity, and availability (Craigen et al., 2014).

Financial Technology Products: The Basel Committee on Banking Supervision (2018) identifies key FinTech innovations across investment management, payment and settlement, financing and lending, and market support services. Technologies such as AI, cloud computing, and blockchain are central to these developments, reflecting the transformative impact of modern technology on financial services. The following table illustrates these components as stated in the committee's 2018 report:

Table (1): Financial Technology Products

Sectoral Innovations in Financial Technology			
Investment Management Services	Payment, Clearing, and Settlement Services		Credit, Deposits, and Capital Raising Services
High-frequency trading	Wholesale payments	Retail Payments	Crowd-funding
Copy trading	Value transfers	Electronic wallets	Lending markets
E-commerce trading	Forex wholesale	Peer-to-peer transfers	Mobile banking
Robo-advisors	Digital trading platforms	Digital transfers	Credit rating
Market Support Services			
Gateways and data aggregators			
Ecosystems (infrastructure, open-source, APIs)			
Data applications (big data analytics, machine learning, predictive modeling)			
Distributed ledger technology (blockchain, smart contracts)			
Security and authentication (customer identification and authentication)			
Cloud computing			
Internet of Things and wearable technologies			
Artificial intelligence			

Source: Prepared by researchers, based on (Basel Committee on Banking Supervision , 2018).

The above table reflects the diversity of sectoral innovations identified by the Basel Committee on Banking Supervision, which

illustrate the digital transformation in the financial sector. The development of payment and settlement services has improved the speed

and efficiency of financial transactions, while digital financing and lending markets have contributed to enhancing financial inclusion and providing innovative financing alternatives. On the other hand, digital investment management brought a qualitative leap through robo-advisors and smart trading platforms, which increased the efficiency of asset management. Supporting technologies for markets, such as artificial intelligence and blockchain, have played a decisive role in strengthening financial security and big data analytics, thereby contributing to improved investment decisions and risk reduction.

The Role of Information and Communication Technology (ICT) in Strengthening Financial Technology (FinTech)

FinTech relies on pillars such as digital infrastructure, AI, big data analytics, cybersecurity, and blockchain. ICT provides the essential tools and systems that enable these pillars to function efficiently, making it a key enabler of FinTech innovation and growth. Robust ICT infrastructure, advanced analytics, and effective cybersecurity are critical for the development and success of digital financial services.

Table (2): The Role of Information and Communication Technology (ICT) in Strengthening Financial Technology (Fintech)

Practical Dimension (Pillars)	Role of Information and Communication Technology (ICT)	Impact on Financial Technology (FinTech) and Resulting Financial Services
Digital Infrastructure	Enhances connectivity and speed through 5G, fiber optics, and IoT.	Facilitates digital payments, mobile banking, electronic wallets, and digital bank adoption.
Big Data Analytics	Processes large volumes of financial data using AI and machine learning.	Improves credit assessment, digital lending, crowdfunding targeting, and risk analysis.
Cybersecurity Technologies	Secures data and financial transactions via encryption, multi-factor authentication, and biometrics.	Builds trust in digital transactions, supporting online banking, payments, and digital insurance.
Blockchain Technology	Provides decentralized, secure systems for transaction verification.	Enables smart contracts, cross-border payments, digital assets, and cryptocurrencies.
Mobile Financial Services	Integrates smartphones and apps into financial systems.	Expands access for unbanked populations, supports instant transfers and electronic payment wallets.
Cloud Computing	Offers flexible and secure platforms for data storage and processing.	Supports fully digital banks (Neobanks) and online crowdfunding platforms.
RegTech (Regulatory Technology)	Automates compliance and regulatory processes via AI and predictive analytics.	Enhances regulatory efficiency, transparency, and reduces legal risks in financial services.
Artificial Intelligence (AI)	Develops advanced algorithms for market analysis and risk forecasting.	Supporting robo-advisors, credit analysis, and dynamic pricing of insurance services.

Source: Prepared by researchers, based on (Basel Committee on Banking Supervision , 2018); (Kyari et al., 2021); (Zhenghui et al., 2022); (Ryan, 2024).

Recent literature emphasizes ICT as a key driver of FinTech adoption, financial inclusion, and economic transformation. Studies in Africa (Sanga & Aziakpono, 2024; Mothobi & Kebotsamang, 2024) highlight that ICT infrastructure and network coverage enable innovation, digital finance, and access for unbanked populations. Systematic reviews (Hornuf et al., 2025) note that most indicators

focus on financial inclusion rather than technological capacity, reflecting gaps also observed in WAEMU. International evidence from Latin America, the Caribbean, and Southeast Asia shows that ICT-enabled FinTech ecosystems enhance digital payments, e-wallets, lending, and economic growth, especially when supported by robust regulatory frameworks. Collectively, these findings

suggest that ICT-FinTech interactions drive structural transformations in financial systems, strengthen financial stability, and promote sustainable economic development.

Method

This section presents the study population and sample, defines the study variables, and identifies the data sources. It also outlines the statistical software and tools employed for data processing and analysis.

Study Population and Sample

The study focuses on the West African Economic and Monetary Union (WAEMU), comprising eight countries that share a common currency (CFA franc) and unified monetary policies under the Central Bank of West African States (BCEAO). WAEMU countries face similar challenges, including limited traditional financial inclusion and high reliance on informal financial services, making FinTech a strategic tool to enhance access to financial services. The region has experienced rapid growth in digital financial services, such as mobile payments, electronic wallets, and digital banking, supported by unified

regulatory frameworks that accelerate FinTech adoption (Ahamadou & Agada, 2023).

For empirical analysis, the study sample includes six WAEMU countries—Côte d'Ivoire, Benin, Burkina Faso, Niger, Senegal, and Togo—while Guinea-Bissau and Mali were excluded due to insufficient data on ICT goods imports, the study's independent variable. The BCEAO database provides reliable financial and technological data, enabling precise econometric assessment of the ICT-FinTech relationship.

Study Variables

This study examines the impact of ICT on FinTech in WAEMU countries (2012–2023). FinTech, the dependent variable, is measured by the usage rate of electronic money services (active accounts as a share of the adult population) using BCEAO data. ICT, the explanatory variable, is measured by ICT goods imports as a percentage of total merchandise imports, using World Bank data. Variable selection was guided by data availability, economic theory, and prior research.

Table (3): Study Variables and Data Sources

Indicator	Definition	Source
Dependent Variable (Financial Technology)		
Rate of use of electronic money services (adult population base and number of active electronic money accounts)	The study's dependent variable, the Rate of Use of Active E-money Accounts (RUAEM), measures the proportion of active electronic money accounts to the total adult population, with activity defined as use at least once in the previous 90 days (BCEAO). Expressed as a percentage, RUAEM reflects FinTech adoption, the substitution of cash with digital alternatives, and the maturity of digital financial infrastructure contributing to financial inclusion.	(Banque Centrale des États de l'Afrique de l'Ouest, s.d.)
Explanatory variable (ICT expressed as ICT Goods Imports in Total Imports)		
ICT goods imports (% of total goods imports)	The independent variable, Share of ICT Goods Imports in Total Imports (ICIGI), is the ratio of the value of imported ICT goods to total imports, based on the UNCTAD classification (computers, communication equipment, consumer electronics, and components). Expressed as a percentage, ICIGI serves as a proxy for ICT diffusion, digital infrastructure readiness, and the enabling environment for digital financial services.	(World Bank Group, s.d.)

Source: Prepared by researchers, based on the sources indicated in the above table.

The use of ICT goods imports as a proxy for information and communication technology is

justified by the structural characteristics of WAEMU economies, where domestic ICT

production is limited and imports constitute the primary channel for accessing advanced digital technologies. Accordingly, the share of ICT goods imports in total imports serves as a meaningful indicator of technological penetration and digital readiness, both of which are essential enablers of FinTech adoption.

Statistical Programs and Tools Used in Data Processing

This study aims to measure the impact of ICT on FinTech in WAEMU countries (2012–2023) using panel data analysis in EViews 13.

Results

This section critically examines the impact of ICT, proxied by the share of ICT goods imports, on the development of FinTech in WAEMU countries during the period 2012–2023. The analysis begins with a careful assessment of the stationarity of the time series, given the relatively long study period and the potential presence of structural breaks or trends. The relationship is then rigorously estimated using pooled, fixed, and random effects models. These models are systematically compared to identify the most appropriate specification, after which a comprehensive series of diagnostic tests is performed to ensure the robustness, validity, consistency, and reliability of the selected

model, providing confidence in the empirical findings regarding the critical role of ICT in promoting financial technology, enhancing digital financial inclusion, and supporting sustainable economic development in the region.

Testing the Stationarity of Time Series

In the context of panel data models, econometric theory provides several tests for examining the stationarity of time series, known as unit root tests. Among the most important of these tests are (Baltagi, 2005):

- ADF Fisher χ^2 (ADF) test;
- Phillips-Perron Fisher χ^2 (PP) test;
- Im, Pesaran, and Shin (IPS) test;
- Levin, Lin, and Chu (LLC) test.

These tests are essentially based on the following hypotheses:

- Null hypothesis (H_0): The time series contains a unit root, which indicates non-stationarity;
- Alternative hypothesis (H_1): The time series does not contain a unit root, i.e., it is stationary.

By using EViews 13, the results of the unit root stationarity tests for the study variables will be extracted and presented in the following table.

Table (4): Stationarity Test of Study Variables.

Variables	Tests Summary			
	PP	ADF	IPS	LLC
RUAEM	0.0003	0.0000	0.0000	0.0000
ICIGI	0.0000	0.0000	0.0000	0.0000

Source: Prepared by researchers, based on EViews 13 outputs (See Appendix: 01).

The panel unit root tests (PP, ADF, IPS, and LLC) conducted for the study variables indicate that both the dependent and independent variables are stationary at level ($I(0)$). Specifically:

- The dependent variable, rate of use of electronic money services (RUAEM), shows highly significant results across all

tests (PP: 0.0003, ADF: 0.0000, IPS: 0.0000, LLC: 0.0000), confirming its stationarity at level;

- The independent variable, share of ICT goods imports in total imports (ICIGI), also demonstrates strong stationarity, with all p-values equal to 0.0000;

These findings provide a solid basis for applying panel estimation techniques directly at level, ensuring the reliability of subsequent econometric analyses and interpretations of the relationship between ICT goods imports and financial technology adoption.

Results of Estimating the Impact of Information and Communication Technology on Financial Technology in a Sample of WAEMU Countries for the Period (2011–2023)

Table (6): Results of Estimating the Impact of Information and Communication Technology on Financial Technology in a Sample of WAEMU Countries for the Period (2012–2023)

Dependent variable (Rate of use of electronic money services (RUAEM))			
Explanatory Variables	Pooled Regression Model	Fixed Effects Model	Random Effects Model
Constant	16.76325 *** (0.0050)	2.606863 *** (0.0004)	6.425544 *** (0.0000)
ICTGI	4.303952 ** (0.0222)	9.526548 ** (0.0124)	8.965845 *** (0.0000)
R^2	0.506582	0.615482	0.695485
Adj R^2	0.405482	0.548541	0.665482
F-statistic	1.168954	4.415834	4.653581
Prob (F-statistic)	0.000000	0.000085	0.000000

*, **, ***, Indicates the statistical significance of the t-statistic at the 10%, 5%, and 1% levels, respectively

Source: Prepared by researchers, based on EViews 13 outputs (See Appendices: 02, 03, 04).

From the estimation results of the impact of information and communication technology on financial technology in a sample of West African Economic and Monetary Union (WAEMU) countries during the period (2012–2023), for the three models we find:

Pooled regression model: The results of this model were as follows:

- The constant term is 16.76325 ($p = 0.0050$), representing the baseline level of RUAEM when ICTGI is zero;
- The ICTGI coefficient is 4.303952 ($p = 0.0222$), statistically significant at the 5% level, confirming a positive relationship between ICT imports and electronic money usage, although smaller than in the other models;
- The $R^2 = 0.506582$ indicate that approximately 50% of the variation in

The following table presents the results of estimating the impact of information and communication technology on financial technology in a sample of West African Economic and Monetary Union (WAEMU) countries for the period (2011–2023), according to the pooled regression model, the fixed effects model, and the random effects model.

RUAEM is explained by ICTGI, suggesting moderate explanatory power;

- The F-statistic = 1.168954 ($p < 0.001$) confirms the overall significance of the model, although it is weaker compared to REM and FEM;
- PRM assumes homogeneity across countries, providing a general overview of the relationship between ICTGI and RUAEM without controlling for country-specific effects.

Fixed effects model: The results of this model were as follows:

- The constant term is 2.606863 ($p = 0.0004$), representing the country-specific baseline effects after controlling for unobserved heterogeneity;
- The coefficient of ICTGI is 9.526548, significant at the 5% level ($p = 0.0124$), indicating that within-country variations in

ICT imports strongly influence the adoption of electronic money;

- The explanatory power of the model is substantial, with $R^2 = 0.548541$ and Adjusted $R^2 = 0.548541$, meaning that over half of the variation in RUAEM is explained by ICTGI;
- The F-statistic = 4.415834 ($p < 0.001$) indicates that the model is statistically significant overall;
- By controlling for country-specific effects, FEM isolates the impact of changes within each country, providing insights into how ICT development drives digital financial adoption locally.

Random effects model: The results of this model were as follows:

- The constant term is 6.425544 ($p < 0.001$), showing that even at zero ICT import share, there is a baseline level of RUAEM;
- The coefficient for ICTGI is 8.965845 with a p-value < 0.001 , indicating a highly significant positive impact of ICT goods imports on the rate of electronic money usage. This suggests that an increase in the

share of ICT imports strongly facilitates digital financial adoption across countries;

- The model explains 66.55% of the variance in RUAEM ($R^2 = 0.695485$), reflecting a high explanatory power;
- The overall F-statistic = 4.653581 ($p < 0.001$) confirms the joint significance of the explanatory variable and the robustness of the model;
- The REM captures both within- and between-country variation, making it suitable for analyzing the effect of ICT across the panel while accounting for heterogeneity.

Comparison tests

To identify the optimal model for estimating ICT's effect on FinTech in WAEMU countries (2011–2023), two tests were conducted: the Poolability (Fisher) test, which compares the pooled and fixed effects models, and the Hausman test, which selects between fixed and random effects models. The table below presents the results determining the most suitable model for each case.

Table (7): Results of Model Selection Tests for the Impact of Information and Communication Technology on Financial Technology in a Sample of WAEMU Countries for the Period (2011–2023)

Fisher Test			
Tests	Stat.	d.f.	Prob.
Cross-section F	5125154	(6.21)	0.0061
Cross-section Chi-square	24.454258	5	0.0044
Hausman Test			
Tests	Chi-sq. Stat	Chi-Sq. d.f.	Prob.
Cross-section random	0.855616	1	0.4287

Source: Prepared by researchers, based on EViews 13 outputs (See Appendix: 05).

Poolability Test: The Poolability (Fisher) test determines whether a common model can be applied across all cross-sectional units. The null hypothesis (H_0) assumes homogeneity, supporting a pooled model, while the alternative (H_1) indicates heterogeneity, requiring a fixed effects model (Xu et al., 2007). In this study, the calculated F exceeded the critical value at 1% significance, leading to

rejection of H_0 and confirming that the fixed effects model is appropriate for accounting for country-specific differences.

Hausman Test: The Hausman test compares fixed and random effects models to identify the most efficient estimator (Hall & Asteriou, 2007). (H_0) favors the random effects model, assuming country differences are random and uncorrelated with independent

variables, while H_1 favors fixed effects. In this case, the test statistic (0.855616) yielded a P-value above 10%, leading to acceptance of (H_0) and selection of the random effects model as the most suitable for analyzing the impact of ICT goods imports on FinTech in WAEMU countries (2012–2023).

Table (8): Autocorrelation Tests for Residuals of the Random Effects Model

Test's	Test Statistic	p-value
Breusch-Pagan LM	128.9711	0.0000
Pesaran scaled LM	20.80819	0.0000
Pesaran CD	11.22398	0.0000

Source: Prepared by the authors based on EViews 13 outputs (See Appendix: 06).

As shown in the table above, the p-values of all three tests are less than 5%, indicating the absence of autocorrelation in the random error terms (residuals). This implies that the estimated parameters of the model are efficient, exhibiting minimum variance. Consequently, the random effects model is statistically valid and can be confidently used for interpretation in accordance with economic theory.

Discussion

After confirming the suitability of the random effects model, the final equation for ICT's impact on FinTech in the six WAEMU countries (2012–2023) is formulated as follows:

$$RUAEM = 6.425544 + 8.965845 * ICTGI$$

(0.0000)

The results indicate a positive and statistically significant impact of ICT goods imports (as a percentage of total imports) on the usage of electronic money services in WAEMU countries during 2012–2023. Specifically, a one-unit increase in ICT goods imports corresponds to an 8.9658-unit increase in the electronic money usage index, measured by the adult population and active accounts, at the 1% significance level.

From an economic perspective, the findings highlight the pivotal role of ICT as the foundational digital infrastructure supporting FinTech development. In the studied WAEMU

Model Diagnostic Tests (Model Adequacy):

Following the selection of the random effects model as the most appropriate specification, its adequacy was assessed using the Breusch-Pagan LM, Pesaran scaled LM, and Pesaran CD tests. The results are summarized in the table below:

countries (Côte d'Ivoire, Niger, Benin, Burkina Faso, Senegal, and Togo), limited traditional financial infrastructure necessitates a shift toward digital solutions to enhance financial inclusion. Higher imports of ICT goods—such as smartphones, electronic payment devices, and communication systems—facilitate access to mobile banking, digital wallets, and online platforms, expanding digital payment adoption, reducing cash reliance, and strengthening regional financial integration.

ICT directly enhances the efficiency, security, and transparency of financial transactions. In countries with developing digital infrastructure, increased ICT imports accelerate transaction speed, reduce costs, and build trust in digital platforms. Advanced technologies, including artificial intelligence and blockchain, further secure transactions, promoting the adoption of electronic financial services. The observed rise in the Rate of Use of Active E-money Accounts (RUAEM) thus reflects the advancement of FinTech in the region.

The relationship between ICT and FinTech exhibits dynamic feedback effects. Greater ICT availability stimulates demand for digital financial services, prompting financial institutions and FinTech firms to innovate and expand their offerings. Rising adoption, in turn, incentivizes further ICT investment by

governments and the private sector, creating a virtuous cycle that reinforces digital transformation in the financial sector. Over time, sustained ICT adoption enhances financial system efficiency, reduces costs of traditional transactions, promotes transparency, and supports economic stability. In WAEMU countries, increased ICT goods imports also facilitate regional financial integration, lowering barriers between national markets and fostering intra-regional trade through advanced digital payment infrastructures.

The effect of ICT imports is not uniform across WAEMU countries. The random effects model accounts for country-specific intercepts, reflecting differences in regulatory frameworks, digital infrastructure, and FinTech adoption levels. These disparities highlight the need for complementary measures, such as digital literacy initiatives, supportive regulations, and infrastructure development, to maximize the benefits of ICT imports.

From a macroeconomic perspective, ICT-enabled financial services offer significant growth potential. By facilitating faster, more efficient, and cost-effective transactions, they improve market functioning, enhance access to finance for small and medium-sized enterprises, and increase the velocity of money, thereby boosting overall productivity. These developments also strengthen financial stability by reducing fraud and operational inefficiencies, enhancing monitoring of financial flows, improving regulatory oversight, and increasing resilience to liquidity shocks and informal sector volatility.

The findings align with evidence from Southeast Asia and Latin America, where higher ICT penetration has been linked to greater mobile banking adoption and expanded financial inclusion (Demirguc-Kunt et al., 2018; Berkmen et al., 2019). In WAEMU countries, however, the effect appears more

pronounced, likely due to initially lower digital infrastructure and the centrality of ICT imports as the primary channel for technological adoption. These results highlight the critical role of ICT goods imports in driving FinTech development, expanding financial inclusion, stimulating economic activity, and strengthening financial system stability. Targeted investments in digital infrastructure, including imported technologies, can therefore yield measurable improvements in access to financial services, transactional efficiency, and sectoral resilience.

Conclusion

This study was conducted to examine the impact of information and communication technology and financial technology in a sample of WAEMU countries during the period (2012-2023), thereby confirming the importance of digital infrastructure in promoting the use of digital financial services. Through econometric analysis, a set of key findings was reached:

- The study showed a positive and statistically significant effect of information and communication technology on financial technology in WAEMU countries during 2011-2023;
- An increase of one unit in ICT goods imports leads to a rise of 5.654253 units in the electronic money services usage index at a significance level of 10%;
- ICT goods imports contributes to the expansion of digital wallets and the enhancement of access to digital banking services in the studied WAEMU countries;
- Technological development contributes to improving the speed and security of financial transactions, reducing their costs, and strengthening trust in digital financial solutions in the studied sample;
- Despite the positive effect of ICT goods imports, its impact differs among WAEMU

countries, reflecting differences in the level of digital infrastructure, regulatory frameworks, and the extent of the spread of digital financial services in each country.

Proposals and Recommendations

Based on the study's findings, the following recommendations are proposed:

- Increase ICT goods imports to enhance the quality and usage of digital financial services;
- Develop robust regulatory frameworks to strengthen the FinTech environment and ensure secure digital transactions;
- Promote regional cooperation among WAEMU countries to foster digital financial innovation and broader financial integration;
- Improve digital infrastructure, particularly in countries with weak communication and internet networks, to support inclusive FinTech adoption;
- Recognize sustainable ICT goods imports as a key driver for advancing FinTech, facilitating digital transformation, enhancing financial stability, and improving the efficiency of digital banking systems in WAEMU countries.

Study Limitations

Despite robust results, this study has limitations. It focuses on six WAEMU countries, limiting generalizability. Data constraints on ICT goods imports and electronic money usage restrict the study period (2012–2023) and the inclusion of additional variables. The scarcity of updated ICT and FinTech indicators forces reliance on proxies, such as ICT goods imports. Unobserved factors, including macroeconomic shocks and policy changes, may also affect results, underscoring the need for expanded datasets and refined indicators in future research.

Directions for Future Research

Future research should expand the sample to additional WAEMU or African countries and use more comprehensive, up-to-date ICT and FinTech indicators, including ICT production, software use, digital literacy, and innovative platforms. Adding controls such as income, connectivity, regulation, and macroeconomic shocks would improve robustness. Longitudinal and cross-regional studies could clarify ICT's dynamic effects on digital finance, financial inclusion, economic growth, and stability, while identifying context-specific drivers and best practices.

List of Abbreviations

ICT: Information and Communication Technology

Fintech: Financial Technology

WAEMU: West African Economic and Monetary Union

BCEAO: Central Bank of West African States

EM: Electronic Money

GDP: Gross Domestic Product

Disclosure Statement

The authors declare that they have no relevant or material financial interests related to the research described in this paper.

- **Ethical approval and consent to participate:** The datasets analyzed during the current study are available from the corresponding author upon reasonable request. Data sources include the World Bank and the Central Bank of West African States (BCEAO).
- **Availability of data and materials:** The datasets used in this study are available from the corresponding author upon reasonable request. Data were sourced from the World Bank and the Central Bank of West African States (BCEAO).

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