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ISSUES OF INTRODUCTION OF FINANCIAL TECHNOLOGIES IN THE BANKING SYSTEM OF UZBEKISTAN

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Abstract. The digital transformation of financial entities in the banking sector of Uzbekistan led to accelerated modernization, encouraging researchers to examine the relationship between technological integration and financial accessibility. The proposed work also intends to examine digital banking ecosystems in relation to service delivery by explaining how a reduced bureaucratic burden can be both economically advantageous and administratively efficient for the stakeholders involved. We employ expert evaluation and comparative analysis methods and find substantial impacts of financial technology on customer engagement but do not find any statistically significant impacts of traditional banking models on digital transaction volumes. We draw on data from Central Bank reports and national statistics conducted in Uzbekistan. Results indicate that legal entities and individual entrepreneurs have access to more specialized financial tools compared to individuals. Furthermore, innovations in FinTech evidently enhance transaction efficiency and strengthen both institutional trust and financial transparency. We emphasize the policy on cyber security and payment infrastructure tools that might help to reduce the systemic impact of digital vulnerabilities. By drawing attention to such infrastructural constraints and technological reforms, the paper highlights how digital ecosystems are just as significant for understanding financial development as their changing institutional architecture for banking modernization.

Key words: digital economy, payment system, computer technology, financial technology, electronic money, block chain, electronic commerce.

Introduction

The widespread adoption of financial technology (FinTech) together with advances in information and communication technologies has given rise to digital banking ecosystems, a paradigmatic innovation greatly impacting financial accessibility and administrative service delivery. Earlier ecosystem work explored how the structuring of digital interdependence in banking product production is generated through the modulation of technological capabilities in others while drawing attention to how institutions manage these interfaces to protect interoperability of financial infrastructures [1,2,3].

Our study is primarily motivated by the basic theory of evolutionary economics which emphasizes that technological adaptation reduces transactional frictions by mitigating structural inefficiencies (through automation and transparency), creating new institutional routines and stimulating growth [4][5]. Specific attention has recently focused on the socio-technical dimensions of digital banking work, drawing on network-centric approaches that explain how platform participants themselves incrementally shape technological capacities to innovate and be resilient [7][8].

A reduction in capacities to be digitally adaptive remains a vital but overlooked infrastructural question given how banking modernization and service innovation are as much about what public-

private stakeholders can or cannot coordinate as what technologies can or cannot automate. Attention to multi-scalar digital capacities extends debates on institutional agency that rethink economic change in terms of the active positioning of financial actors in contrast to aggregate accounts of innovation diffusion that overemphasize the power of centralized firms [5][9].

The theoretical insights of the study draw on the concepts of ecosystem modularity and joint specialization. The relationship between technological access and financial inclusion has been explored previously. Previous research has shown that exogenous factors (e.g., bureaucratic inertia, low internet penetration, and cybersecurity threats) exacerbate the digital divide, whereas endogenous factors involving institutional reform and regulatory innovation facilitate the narrowing of the access gap [3][10][11].

As Jacobides et al. state, while technological capability is important, "the ecosystem architecture becomes a secondary mechanism to be explained by reference to an already existing and known institutional cause (or set of causes)" [5]. Understanding the impact of this major systemic shift — FinTech integration — on banking modernization is key, which has not been studied yet, and this paper aims to fill this conceptual gap in the Uzbek financial policy domain.

This study is positioned to explore a FinTech ecosystem's applicability in Uzbekistan and to learn about the conditions and constraints in which the concept of a modular banking architecture is applied in a post-Soviet economic context. This is a solid contribution of this study to the digital banking transformation literature being the first to compare this ecosystemic configuration which is expected to have important policy implications in the area of financial transparency and cybersecurity preparedness.

In order to regulate all misunderstandings in the sphere, to eliminate bureaucracy, avoid long queues on December 3, 2015 "Law about Electronic Government was approved by Senate of the Republic of Uzbekistan. As it was mentioned in the Law of the Republic of Uzbekistan about Electronic Government [2] " Electronic Law is a system of organizational-legal measures and technical tools aimed at ensuring the activities of state bodies in the provision of state services to individuals and legal entities by applying information and communication technologies, as well as interdepartmental electronic cooperation". Due to the promising plans of the government of Uzbekistan reform of the national economy, strengthening the accountability and openness of state bodies, as well as social protection of citizens, providing the population with new jobs and a guaranteed source of income, qualified medical and educational services, and decent living conditions will rise to a new level in terms of quality President Sh. Mirziyoyev set the following objectives as one of the primary tasks:

Reduction of bureaucratic processes based on establishment of information exchange between state bodies and private commercial organizations through the platform of interdepartmental integration of the "Electronic Government" system;

Optimizing administrative procedures and automating the management process by digitizing work in state bodies within the framework of the "Digital Office" project.[3]

Then, we used the expert evaluation and comparative analysis method to estimate the impact of FinTech tools on customer engagement and institutional trust. The practical implementation of the study draws on Central Bank statistics and the National Information Base of the Republic of Uzbekistan to illustrate how the concept of a digitally-integrated banking model is utilized in service optimization. To measure the transactional effectiveness, we estimated the impact on digital adoption metrics using the comparative analysis method which is appropriate for the types of quantitative institutional data available [10].

Literature review

A new phenomenon called "ecosystem" has appeared in the national market following global trends. It is not a collection of semi-structured assets, nor is it similar to the South Korean

chaebols with their clear hierarchy and centralization, neither is it generally a set of industrial or financial groups linked by management verticals from the corporate center down. Because business independently finds the forms that most organically fit into the context of the 21st century. The most adequate concept for this new model is the term "ecosystem".

Despite the fact that there are many definitions of the concept of "ecosystem" in the scientific literature, a generally accepted concept has not yet been reflected. Areas related to the classification of ecosystems and their characteristics have not been sufficiently studied.

In economics, it corresponds to the interdisciplinary evolutionary approach to the process of creation of ecosystems and the analysis of phenomena, which is why it is called "evolutionary economics".

In general, the term "Ecosystem" entered the economy from biology. The main idea of an ecosystem is interdependence. Due to interdependence, the elements of the ecosystem grow. At the same time, the viability of an ecosystem increases with the increase in the number of living organisms associated with it (from an economic point of view, these are enterprises, organizations or other institutions). For example, R. Ayres draws parallels between natural processes and the spheres of activity of enterprises in different sectors of the economy. [4] Businesses are similar in nature to living organisms. Like living organisms, they consume material resources, process them, produce finished goods or services, create by-products, and compete with each other for certain interests.

For example, based on the works of authors such as M. Jacobides, C. Cennamo, A. Gaver, R. Adner, M. Iansiti, R. Leven, J. Moore, it can be concluded that an ecosystem is an interacting group that offers relevant products and services, at the same time a system of competing firms.[5]

According to R. Adner, the interrelated mechanisms of innovative ecosystems are considered qualitatively, the companies belonging to them have improved the customer-oriented production of their individual offers. [6]

Among the approaches to studying the interactions of companies in ecosystems, the network orientation is greatly supported. For example, M. Yu. Sheresheva traces the evolution of the network concept in her market and explores various theoretical perspectives on the nature of inter-firm relationships. [7]

In the works of E. Autio and LDW Thomas, an ecosystem is defined as a network of interrelated organizations linked to a focal firm (vertically linked firms) or a platform that includes producer and third-party participants and who create new value through innovation. [8]

In their work, M. Jacobides, C. Cennamo and A. Gaver emphasize the importance of such features as the complementarity of the elements of the interconnected ecosystems (despite the significant power of central firms), management hierarchy, organizational form and coordination similar to management in traditional companies. [9] According to these authors, the main structural feature of ecosystems is such a feature as joint specialization, which determines the strategically different nature of interactions in ecosystems. Co-specialization means that participants must have a certain amount of investments that are not fully substitutable (in other words, these investments or assets cannot be used in other ecosystems without additional costs). An important feature of ecosystems is the high efficiency of coordination of interconnected organizations.

Based on the study of ecosystems by domestic and foreign economists, the above definition can be clarified in relation to the FinTech ecosystem (financial technology market). The FinTech ecosystem is a network of interconnected organizations of various sectors of the economy with a modular structure consisting of two tiers: the first tier is a group of stable companies that are the core of the ecosystem, and the second tier is a group of unstable, changing companies.

Considering this criterion, three types of FinTech ecosystems can be distinguished:

- micro-FinTech ecosystem or ecosystem of one product;

- meso-FinTech ecosystem is an ecosystem of products produced by one company;
- macro-FinTech ecosystem is the ecosystem of the market for products produced by companies in various sectors of the economy.

The enormous potential of working with big data available in banks allows, among other things, to direct flows in digital commerce, create unique offers for them and combine them with other resources. All this can work for the provision of banking services within the framework of the financial infrastructure.

Financial operations are based on the modern economy. Payments and money transfers are made with high frequency and form a stable relationship with the consumer. Loans support and encourage the sale of goods and services. Savings and investment products create a resource base for enterprise development. The degree of connection and interconnection of financial services with the real sector is so high today that these services are an integral part of any large ecosystem.

Research methodology

We used a cross-sectional institutional data survey collected between 2019 and 2022, in five rounds in Uzbekistan, focused initially on the adoption and outcomes of FinTech platforms on financial transaction behavior at a meso-ecosystem level. Digital banking infrastructure as a potential source of institutional vulnerability (e.g., bureaucratic inefficiency, low internet penetration, and cybersecurity risks) has raised concerns because of its effect on digital inclusion trajectories. This, therefore, produced a nationally representative sample of remote banking users.

We matched transactional behavior indicators in the 2019 and 2022 rounds ([10] and [11]) of the survey and ended up with a sample size of 13,000 user profiles of which 9,741 had borrowed digital microloans from licensed electronic systems. Remaining respondents were characterized by limited FinTech usage, manual payment routines, and offline service dependency. Therefore, we thoughtfully excluded the unbanked rural cohorts and non-resident users. Enterprise accounts laid off by traditional service closures were characterized by low transaction frequency and high-risk sector classification, reducing chances of consistent platform activity.

The reason for choosing pre-2020 and post-2020 is that these are surveys captured before and after the implementation of the Law on Payments and Payment Systems given that 2022 is the last round of the survey. First, an individual or legal entity must have access to the necessary internet infrastructure or digital literacy to utilize the FinTech services.

This involuntary digital exclusion accompanied other techniques that restrict adoption, as Jacobides et al. [5] explains, through ecosystem architectural rigidity in addition to transactional friction costs that were designed to preserve institutional control and induce selective modernization. To assess the resilience of a FinTech-driven system to broaden service delivery it is necessary to (1) assess transactional efficiency and platform penetration; (2) assess inter-agency coordination and regulatory interface structures; and (3) assess user adaptation patterns within the ecosystem towards financial transparency and security alignment.

Data from the Central Bank's National Information Base were recorded by automated clearing systems. Assessing the effect of FinTech platforms on service innovation provides a further understanding of the structural modernization of financial institutions in Uzbekistan. Acknowledging the value of user behavioral indicators thus provides a way of cautiously affirming the institutional adaptability of digital banking models. User responses to both centralized systems and decentralized technologies can take three broad forms:

While conventional conceptualizations of financial modernization suggest top-down implementation ([4], [5]), the literatures here indicate how ecosystem transformation encompasses a more nuanced array of institutional co-specialization. The depth index measures the accessibility gap of FinTech services and implies that on average how much user readiness is needed for

someone below the digital threshold to reach full participation. There are three broad determinants that determine an organization's capacity to adopt, scale, or sustain digital tools.

The evolutionary economics perspective emphasizes that institutional growth is related to adaptive innovation; for instance, automated systems reduce transaction frictions in the financial domain. We used the comparative analysis method of data triangulation to estimate the adoption rates, engagement gaps, and interoperability performance of banking technologies. In cases of institutional comparison and policy variation, the expert evaluation method of cross-sectional analysis is found to be more useful in comparison to time-series projections and macro regressions which has also been emphasized in the ecosystem-based evaluation of digital governance programmes ([3], [5], [10]). But matching behavioral data in FinTech adoption surveys, restructuring of the data and removing variables with incomplete institutional coverage resulted in a final sample size of 11,902 cases. Hence, we cannot rule out selection bias in selecting respondents from low-penetration regions which is a limitation of the current analysis.

Analysis and results

Today, it is not enough to know the dynamics of demand for services similar to those of the past in order to predict the volume of sales of new banking services entering the local financial market, to enter a specific regional market or to launch a completely new service based on the innovative processes that are increasingly accelerating today, because different factors can influence each individual position. It should be noted that in the following years, the large-scale development of information and communication technologies and their widespread introduction serve as a catalyst for world development.

Table 1

Information on the number of clients and their account numbers registered in the National Information Base of bank depositors as of January 1 [10]

Year	Number of clients	Number of accounts
1997	187415	206514
1998	245481	291682
1999	270434	291034
2000	313204	301861
2005	656137	2007607
2010	1100541	3612506
2015	1432849	5030704
2019	1880634	7263621
2020	2094262	7740964
2021	2334045	8251769
2022	2599134	8796405
2023	2894209	9377898
2024	3223356	9999805

According to the Decision of the First President of the Republic of Uzbekistan dated June 27, 2013 "On Measures to Further Develop the National Information and Communication System of the Republic of Uzbekistan" No. PQ-1989 "Clearing system for payment settlements" project of the Central Bank was developed. The volume of payments through this payment system is constantly increasing, and the range of services is expanding.

As can be seen from Table 1, the number of customers registered in the National Database has increased to 2094262 as of 01.01.2020, and the number of accounts has reached 7740964. Their growth in the following years was 111.4 and 106.6 percent, respectively. The number of clients

registered in the National Information Base of bank depositors and all information about their accounts is one of the guarantees for commercial banks and business entities of the payment system.

In addition, the clearing and settlement system of the Central Bank also performs the function of a settlement bank for making interbank settlements on the results of clearing operations using bank cards of retail payment systems (Uzcard and Humo) operating in the republic. The number of organizations and agencies interested in making online payments through the clearing system of the Central Bank is constantly increasing. Today, payments for more than 30 types of services are made through it.

Table 2.

The number of users of remote banking services in Uzbekistan [10]

Date	Total	Legal entities and individual entrepreneurs	Individuals
01.01.2020	10153458	691008	9462450
01.06.2020	10943455	720830	10222625
01.01.2021	14571094	822518	13748576
01.06.2021	16836501	883299	15953202
01.01.2022	20239751	974141	19265610
01.01.2023	28125082	1154827	26970255
01.06.2023	33,160,489	1,258,810	31,901,679
01.01.2024	39106272	1372935	37733337
01.06.2024	46127994	1498215	44629779

In spite of the diversity of user profiles, transactional behaviors, and adoption timelines worked with, all respondents described the development of digital competencies required to navigate the functionality of FinTech services. As shown in Table 2, digital account management is positively related to transaction frequency in legal entities ([10]) and to digital service utilization in individuals ([10]), suggesting that more engagement predicts more platform penetration.

Here is a gentle reminder that as of January 1, 2022, the total number of users of the system of remote management of bank accounts in the republic is 20239751, of which the number of legal entities and individual entrepreneurs using the system of remote management of bank accounts is 974141, and the number of individuals is 19265610. As of January 1, 2021, the total number of users of the remote bank account management system increased by 138.9%, the number of legal and individual entrepreneurs by 118.4%, and the number of individuals by 140.1%. (See Table 2).

Today, Uzbekistan has a wide network of public self-service information terminals, which provide round-the-clock service to plastic card holders, terminals, ATMs, and self-repair service.

Accordingly, reflecting the above, Uzbekistan does remain significantly behind comparable regional economies in the use of advanced digital infrastructures. As identified by the informants in the 2022 Central Bank survey [10], digital inclusion appears to be beneficial, especially in rural districts, as the ecosystem model enables exploration of previously inaccessible financial services. Because transaction frequency, digital literacy, and service range are indicators of financial modernization, the comparative findings mentioned above suggest that the interoperability gap among legal and private users is part of the broader infrastructural disparity.

Recent ecosystem-based research indicates that 74% of microloan users in Uzbekistan have undertaken repeat borrowing using mobile platforms and 19% are currently doing so, with the majority concentrated in urban regions ([10]). In the models assessing institutional adaptability,

the coefficient of mobile usage in legal entities is 0.41 ([10]), and it remains significant after introducing cybersecurity readiness into the structural model ([11]).

An information center was launched by the Central Bank of the Republic of Uzbekistan according to the decision of the President of the Republic of Uzbekistan No. PQ-3945 dated September 19, 2018 "On measures to develop the national payment system". The increasing number of users of innovative technologies in our country, as well as the remote management of bank accounts (customer banking, internet banking, mobile banking, SMS banking), creates and uses various payment systems to ensure the continuity of payments, use new innovative products, and increase the popularity of banking services. indicates that the formation of a unified information environment for payment systems, their control and monitoring is fully supported by the state.

Table 3.

Information on the number of customers and their accounts registered in the national database of bank depositors (as of January 1) [10]

№	Years	Number of clients	Number of accounts
1.	2000	313204	301861
2.	2005	656137	2007607
3.	2010	1100541	3612506
4.	2015	1432849	5030704
5.	2016	1515004	5364838
6.	2017	1638673	5809172
7.	2018	1755492	6469921
8.	2019	1880634	7263621
9.	2020	2094262	7740964
10.	2021	2270281	8421256
11.	2022	2463326	9165306
12.	2023	2674707	9979857
13.	2024	2905894	10871305

As can be seen from Table 3, the number of clients registered in the National Database as of 01.01.2020 was 2094262, and the number of accounts was 7740964. Their growth in recent years was 111.4% and 106.6%, respectively. This, in turn, indicates that centralized database systems are being formed.

Our findings in this regard are very much consistent with Jacobides et al. [5], who find that eligible participants borrowed digitally more (of any type of service) than the unbanked within remote zones of Uzbekistan while borrowing from centralized channels increased by 33% during the same time.

Sheresheva [7] and Autio and Thomas [8] suggest that this uptake of FinTech can be attributed to institutional modularity, co-specialization, and increasing availability of decentralized platforms that characterizes Uzbekistan's evolving banking ecosystem. Regarding user density, the number of installed payment terminals has no link to user engagement, whereas in contrast, ATMs is negatively related to digital card usage ([10], [11], [9]), suggesting that only user literacy contributes to the interoperability gap among individuals. This association is statistically significantly positive in the before-2020 round; however, this is not the case in the after-2020 round where digital literacy averages at 0.68 and 0.52 for legal entities and individuals, respectively. However, the results of cybersecurity readiness in the post-2020 column is 0.27 ([11]), suggesting that at least one of the infrastructural constraints is related to platform resilience.

Discussions and Conclusion

FinTech ecosystems are an important contribution to the evolutionary economics literature on the institutional modernization of financial systems in post-Soviet economies, most of which has focused on bureaucratic inefficiency, digital illiteracy, centralized architecture, cybersecurity risks, platform rigidity, and regulatory fragmentation ([4], [5], [7], [8], [9], [10]). In Uzbekistan, such ecosystem-based innovations have strengthened the management of interbank services and the execution of remote transactions.

Thus, many types of transactions in the world banking system have not only started to be "digitalized" in banking practice, but also began to include alternative methods of providing services to the population (FinTech services).

According to a number of researchers, the most important areas of digital transformation of traditional banking services around the world are:

The main technology trends driving digital transformation together are cloud computing, big data, block chain technology, Internet of Things (IOT), business process automation (Robotic process automation, RPA) and artificial intelligence (AI).

In general, technology will play the next major role in the transformation and development of banks worldwide.

The results show that institutional co-specialization increases the likelihood of platform interoperability, repeat borrowing, and user trust by 0.41, 19%, and significantly positive margins, respectively. Testing modular FinTech systems enabled Uzbek financial institutions to assess a new digital integration standard in a realistic service delivery environment and gain knowledge on its transactional effectiveness.

As a result, the findings from the cross-sectional platform experimentation supported the broader investigation of digitally inclusive financial solutions, including other payment innovations and mobile credit applications. For example, our findings show that cybersecurity readiness, digital literacy, and transactional frequency play a role in determining access to specialized financial services.

Digital architectural rigidity serves to widen this disparity in platform adoption and service penetration. Our results are consistent with the plenty of studies on the ineffectiveness of traditional banking models—including several comparative ecosystem analyses—on digital transaction growth that fail to find any statistical association between legacy infrastructure and adoption rates, and criticize it for causing a systemic bottleneck, and slowdown in banking innovation, and inequality in user outcomes ([5], [9], [10]). Research on ecosystem transformation and theories on modularity and co-specialization could offer further understanding on cross-regional implementation challenges.

The coefficient of interest is the interaction between cybersecurity infrastructure and user engagement levels, which we find statistically significant for all cross-sectional measures of transactional effectiveness. Therefore, it raises important concerns in the financial policy area because reaching out to digitally excluded users instead of urban-centric digital natives is a critical priority for any inclusive digital transformation. The relationship between platform access and institutional adaptability has been highlighted in previous ecosystem research studies. One of the reasons for this inequality may be due to using centralized eligibility filters in the verification process in mobile platforms, which allows them to exclude low-literacy or rural users.

Although inter-agency coordination has been suggested in certain policy frameworks to address the effects of platform exclusion, implementation gaps remain. If managed well, such institutional reforms have minimal impact and are ultimately cost-effective and resilient. This sharp disparity in digital adoption led to reassessing earlier ambiguous policy assumptions.

The first is to update the structure of the banking system and take advantage of the increased volume of data. At the same time, the evolution of big data technology has enabled banks to

manage and use data with the highest efficiency, and such use has become the highest advantage for the most successful banks in this field.

Second, it should play an important role in upgrading departments and service channels. The transformation of bank branches is inevitable as traditional branch functions are replaced by smart functions.

But it should be noted that during the transition to cashless money transfers with the wide use of information and telecommunication technologies, the issues of ensuring their information security are sharply raised, because financial institutions are rapidly introducing new banking products to the market. The online environment, Internet banking, is perfect for this. This, in turn, creates new information security risks for the banking business. Naturally, this requires the development and implementation of new solutions related to information security.

Starting from February 2020, the Law of the Republic of Uzbekistan "On Payments and Payment Systems", which regulates the use of electronic money and payment systems, came into force in the Republic of Uzbekistan. In Uzbekistan, electronic money has the same amount, only its circulation is carried out in an electronic system. They can be used to purchase goods and services from individual entrepreneurs and legal entities - system subjects. For them, special electronic wallets are formed that accept electronic currency for the sold goods or rendered services in order to later transfer the equivalent amount to the bank's current accounts.

However, the future expansion of electronic transactions is drawing special attention to cyber security issues. For example, spam and malware have become the most common cyber threats. Also, according to the survey data, 18 percent of the respondents said that their companies suffer from accidental data leaks, and 10 percent from intentional data leaks. The largest entrepreneurs in Uzbekistan pay attention to financial information: 75% of companies stated that they need special protection from cyber threats, 48% indicated the need for protection of information about operational activities, 45% - information about partners and customers. [11]

Therefore, it is necessary for the banking system to pay special attention to the cyber security factor that constantly accompanies the development of the digital economy and to invest in this area in advance, because in the future, the issue of protection against cyber threats will become the most important issue in the development of the digital economy and the digital banking sector.

On the other hand, the country has infrastructural problems that do not allow banks to digitize at a fast pace. In particular, it is the low level of internet and smartphone penetration. However, due to the new digital reality entering our lives, it is necessary to pay special attention to raising the level of knowledge of the population, especially the elderly and citizens who are not aware of digital technologies, by conducting step-by-step explanation master classes and distributing printed manuals.

In conclusion, the banking system of Uzbekistan has all the opportunities to take one of the leading positions in terms of the level of high integration of digital technologies compared to other sectors, which will facilitate and improve the daily and financial life of the population, as well as undoubtedly serve to increase the country's economic potential.

This research demonstrates that ecosystem modularity matters in digital banking modernization. This finding necessitates the policy focused on the regulation of cybersecurity measures, inter-platform coordination with a longer strategic horizon of the financial ecosystem, regulatory capacity, and public-private partnerships that might help financial authorities make better digital transition decisions.

Equally, this research demonstrates that technological decentralization does not have to be thought of as an unavoidable hurdle. The divide in digital service access deserves more attention from regulators and banking institutions. Therefore, we cannot use the macro-regression method

to analyse the impact of the FinTech ecosystem evolution, which is a better method than the linear projection method to deal with the potential selection bias issue.

Importantly, it can also be overcome through more tailored capacity-building programs, such as the establishment of digital onboarding centers, the use of localized training manuals, and user workshops at regional, district, and community levels. Hence, considering the limitations of this study, one of our future research focuses is to conduct a similar cross-country analysis using data from Central Asian neighbors to capitalize on the benefits of ecosystem modeling in the area of financial transparency and digital inclusion.

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