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THE IMPACT OF BLOCKCHAINS IN THE DEVELOPMENT OF RWANDA DIGITAL FINANCIAL ECONOMY

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Abstract

With a more global financial market, it was only a matter of time before there was a shift in financial trading. With a more technological developed economy, the usage of financial technology has started to take president. With Rwanda as an emerging technological developing country, the lure of FinTech has an appeal to the financial service population. However, it does come with its set of problems. This can range from little governmental oversight to limited accessibility to such technology. Although, blockchain do offer challenges, the advantages it possesses keep it in Rwanda forefront as a mean of developing their digital financial economy.

1. Introduction

A blockchain can be best described as a circulated database of records or a public ledger of all transactions or digital events that have been implemented and collective among joining parties. While every exchange in the open record can be affirmed through an agreement from the standard members in the system, as for upon being entered, the data is impossible to delete, with a great example of a very popular financial blockchain would be Cryptocurrency As popular as it is, it however does face a larger controvert as it offers the handling of multi-

billions of dollars with no governmental oversight. This has therefore resulted in many government and financial institutions from not truly investing in it.

However, this has not undermined the rate blockchains has transfigured the digital financial world. With the additional fact that all transactions from past to future will always be accessible has increased the appeal for blockchain technologies to grew in the private financial institutions. Furthermore, with the additional promise of the parties involved being consensual and anonymity has seen it becoming more favorable.

When the pandemic known as COVID-19 hit, there was a widespread effect on the everyday lives of people in a much unexpected way; subsequently governments proceed to endeavor hard to secure lives by forcing lockdowns, testing, isolation, and treatment. The lockdown measures acted as constraining numerous businesses to close and surprisingly businesses are reopened with limitations of implementing social distancing, wearing masks, and restricted number of clients to enter the shop.

When conventional shopping became troublesome for people, they moved to online shopping. This has stemmed in commerce to client (B2C) deals and increment in trade to trade (B2B) E-commerce. The increment in (B2C) deals is especially apparent in online deals of therapeutic or medical supplies, family basics and nourishment items. Orders have fallen, nevertheless, for certain administrations with huge online components, such as tourism services, the widespread has made it clear that e-commerce can be an imperative tool/solution for clients. The utilization of mobile payments has revealed its efficiency as an installment solution/alternative.

Rwanda, like any other nation has built up response mechanisms attempting to stabilize the circumstance and with the results of COVID-19, counting financial drive concedes certain installments, liquidity help, and the government of Rwanda has empowered the utilization of IT for the purpose of coping with circumstance prevailing on the ground, be that as it may, the results of COVID-19 are apparent and exceptionally dangerous.

1.2. Problem Statement

Blockchain has a great potential in numerous fields including financial services, reputation systems, Internet of Things, and so on (Wang et al., 2021). Despite this potential, there are many challenges to overcome in the usage

of blockchain. Bitcoin, which was the first cryptocurrency built on blockchain, has challenges including scalability, privacy leakage, and selfish mining. Efforts to address scalability are storage optimization and redesigning the blockchain. Blending and zero coin are proposed to address security spillage. Lastly, selfish mining can be prevented *by* using random beacons and timestamps so that miners can select fresh blocks (Wang et al., 2021).

Blockchain is the key to integrating technology with financial transfer as Bitcoin has shown that if done properly it can greatly increase the financial market and develop the economy of the given platform. But when we take a look at the uses of blockchain in Rwanda, it has been greatly under use as there are not many privately owned independent financial institutions that have access to the vast technology to successfully run a blockchain. On top of that not many people have access or a desire to adapt to new technology.

This paper will show the benefits of adopting blockchain into Rwanda's financial institutions and how they can be usefully managed to operate at the highest level.

LITERATURE REVIEW

2. The Main Features of Blockchain

Distribution: Blockchains are designed to be physically dispersed. The entries on a blockchain do not sit on a single server, e.g., of a bank or government agency, but are at the same time distributed across many computers that form a network. This means that original copies of the same data are stored in different locations. Even if part of the network goes down, the ledger remains accessible to all other participants in the network. In truth, unless all hubs in the system goes down, the keenness, accessibility, and operability of the record as a whole is maintained. This is a strong resilience property. Imagine proof of educational claims remaining easily available even if a university's server is destroyed in a natural disaster.

In order to ensure that these copies of the same data are fully identical and synced in real time, blockchain technology makes use of various consensus mechanisms. This enables participating parties of the network to computationally find consensus on what information is stored on the blockchain, and, thereby, put trust in the

system and in one another without actually having to know the other participants in the network. Thanks to these consensus mechanisms (Brennen & Kreiss, 2022) and, depending on their formulation, blockchains work without a centralized entity, e.g., an administrator managing the ledger.

Public vs. private, permissioned vs. permissionless blockchains: The attribute of distribution holds especially true for public permissionless blockchains (Richard, 2023). By design, these blockchains operate on the open internet and allow for anyone to read, write, and verify transactions by operating a node in the network. Public permissioned blockchains meanwhile are also accessible on the open internet, but they limit the ability to verify transactions to a selection of participants or by certain conditions.

The openness of public blockchains potentially makes for a high degree of architectural and political decentralization (Manyika et al., 2021) and making them maximally resilient to malicious adaptation. In contrast, private, so-called federated/consortium/syndicate distributed ledger networks are managed by one or several entities that may limit read-and-write access of the blockchain and determine the rule set for verification (Ojanpera et al., 2022).

Stationary: Once a transaction is confirmed by the participating parties and written into the ledger, the protocol does not allow for any changes to be made after-the-fact. This is on the one hand due to the distributed logic and consensus mechanisms of the ledger, but also based on the particular structure of a blockchain. Here. Modern data is stored in self-referencing blocks that are included to an add-only chain. Previously kept data is not overwritten, and review control is nearly outlandish in the open and permissionless blockchains. The specific data structure of conveyed records and blockchains guarantees the integrity of each individual record entry and the precision of the record as a whole. Any attempt to alter the data ex-post would be rejected by the consensus rule, and the attempt itself would become visible to all participating parties. This ensures an extremely high level of data integrity in public/permissionless blockchains. Immutability means that high data quality is particularly important in blockchain systems.

Reward base system: In order to foster the trust in the status of the ledger that blockchain is widely praised for, the technology may rely on Incentivization mechanisms that encourage network participants to behave

positively. As part of a blockchain's consensus mechanism, for example, participants may be rewarded (economically) when positively contributing to the system (i.e., by processing and validating transactions). An example for this reward system is the Bitcoin blockchain, where successful validation of new transactions is rewarded in the payout of bitcoins.

In other scenarios, negative Incentivization is also possible, as participants are discouraged from malicious behavior that would ultimately harm the system and themselves. Such Incentivization schemes, born from game theoretical principles, are a core characteristic of public/permission less blockchain protocols. They can also be adapted for a variety of scenarios and use cases.

By representing certain economic rewards or real-world goods in the form of digital tokens and by defining clear means to earn these tokens, participants of a blockchain can be encouraged to behave in desirable manners. Examples of this are community coin systems that reward the purchasing of local goods instead of imported products (Eyal, 2022).

Computerization: Unlike a centralized database held by a single entity, a blockchain continues to run even if individual participants or machines stop participating in the network. Just like the availability of stored data does no longer depend on a single machine within the network, the processing of code does also no longer run on a single computer or server. Instead, code can run directly on a blockchain, following the logical iterations that it was programmed to process: If transaction A has taken place, then transaction B will automatically be executed. This capacity is also known as smart contracts. Running such an if-then-statement independently from a centralized processing unit or server enables a new level of automation through blockchain technology.

2.1 Common Challenges Blockchain Faces

A number of technical challenges remain as obstacles to a more widespread uptake of blockchain across sectors. Surely, this can be attributed also to the maturity of blockchain as a technology, which is continuously growing with further use cases across the globe.

Range of scope: Currently, the number of transactions that can be executed per time unit on most blockchains is very limited. Due to the size limitations of individual new blocks on the chain and the redundancy of linked previous blocks, the speed of processing transactions is comparably low. Therefore, scaling blockchain-based projects to industry-scale is a key challenge that needs to be addressed or worked around.

Confidentiality: Most blockchains do not currently provide sufficient levels of privacy as required for government and enterprise applications. Whereas the major open blockchains uncover information and metadata freely and forever, numerous private and permissioned blockchains permit a few frames of security. For instance, data may be public among the members of a particular blockchain consortium, but private to non-members. However, private, and permissioned blockchains may not provide for the level of trust and immutability and heavily rely upon their off-chain governance structure to ensure reliability of their content (Barefoot et al, 2020). Moving forward, both private and public blockchains are expected to enhance privacy based on so-called zero-knowledge proofs.

Interoperability: To little surprise, the young technology has not seen sufficient streamlining through standards across sectors and industries. This abandons businesses with troublesome choices on the usage of particular blockchains that are as of now interoperable. While projects are working towards an increase in interoperability, achieving this as an industry-wide standard will require additional time.

Infrastructure: Logically, any blockchain-based system will rely on the existence of functioning and reliable infrastructure, including internet connectivity. While the choice between varieties of blockchains (e.g., private vs. public) may to some degree alleviate this precondition, it remains a key factor of consideration for any implementation, especially in the African context.

In addition to these technical challenges, blockchain technology also commonly faces a number of difficulties in its application due to its technical characteristics and their contextualization in the real world. This specifically entails the following problems:

The digital representation of assets: Representing material and immaterial assets that are not yet in a digital form is an overarching difficulty across sectors. It needs context-specific solving before blockchain technology can be applied successfully. Examples include the traceability of assets in supply chains, e.g., for fashion, pharmaceutical drugs or agricultural goods.

Data quality: Strictly speaking, blockchain technology ensures data integrity and not data quality. The data stored on a blockchain is only as accurate as it was when entered. Especially as data cannot be retrospectively changed, high standards on data quality are required in the application of blockchain technology. In many scenarios, the entry of such high-quality data onto the blockchain poses a particular challenge.

Smart contracts: The automation that blockchain offers by allowing lines of code to be directly programmed on-chain also comes with its own caveats. As the processed code can no longer be amended after it was stored on the blockchain, it needs to fulfill the highest quality standards – similar to data entered on-chain. However, experience of software development proves that programming bug-free code is virtually impossible. Considering this, the lacking ability to fix badly designed smart contracts or to update them when external factors make it poses a further complication for the use of smart contracts.

Integration: Blockchain systems can be difficult to integrate within existing system landscapes. It is thus necessary to include the integration with legacy systems into the technical design choices. Advances towards open, interoperable standards serve this goal.

As much as these limitations should be evaluated within the context of any blockchain-based project, one cannot overstate how the field of blockchain development remains in flux and is rapidly changing.

Therefore, a look at the already feasible use cases and an outlook into the nearest future to ensure enabling environments for soon-to-be-realized approaches remains worthwhile.

2.2 Emergence of Digital Economy in Rwanda

Despite its small size, Rwanda has distinguished itself as a country that has "bet big on digitization," as means to accelerate growth and reduce poverty. Rwanda has already begun to chart an ambitious course for achieving rapid digital transformation. This incorporates contributing intensely to the roll-out of computerized framework, guiding, inventive plans and association with non-profit and for-profit organizations to boost the nation's computerized aptitudes base, growing its open computerized benefit capability and making an empowering environment for advanced benefits and commerce innovation.

Rwanda's ICT sector has been growing rapidly over the last five years, witnessing a 12.7 percent value-added increase in 2014-2018. The World Economic Forum's Networked Readiness Index subsequently rated Rwanda first among East African countries in terms of its status to abuse the openings advertised by ICT to boost development and competitiveness (World Bank 2020)

However, there is room to do more in terms of capitalizing on progress and investments made so far. For Rwanda to use advanced change as a driver of development, work creation and more prominent service delivery, computerized selection needs to uniquely move forward.

Rwanda will need to tackle the affordability of digital devices and services, but also bridge the lingering basic digital skills gap, to increase uptake of digital tools and services among both individual users and Businesses, creating a virtuous cycle of demand that can help propel further expansion and application of digital products and services. However, a lingering digital skills gap emerges a key cross-cutting barrier to increasing digital adoption and expanding digital innovation.

For Rwanda's digital evolution to become truly transformational, the private sector also needs to play a far greater role in spearheading digitization, alongside the ambitious initiatives launched by government, through both expanded innovation selection and support for advancement that can upgrade efficiency, produce modern administrations, and make unused off-farm jobs. However, for the private sector's contribution to the digital economy to increase and for areas like e-commerce to thrive key enablers need to be in place; including greater

adoption of broadband, digital payments and access to a larger market of digitally savvy consumers that allow digitally enabled new companies to quickly scale.

2.3. Rwanda's Blockchain Situation

1) Secrecy

Zero coin is an extension to Bitcoin that provides strong anonymity. Sasson et al., (2022) claim that Zero coin is strong, but it still reveals payments' destinations and amounts. The authors proposed a new currency called Zero cash which they believe is stronger than Zero coin. Zero cash uses decentralized anonymous payment schemes (DAP schemes) which enables users to pay each other privately.

Despite client concerns, solid anonymity shows up to be much of a challenge to law authorities who confront trouble attempting to minimize virtual money laundering. In (Reynolds & Irwin, 2021), the authors analyzed anonymity of online transactions using Bitcoin, the creators analyzed anonymity of online exchanges utilizing Bitcoin. The authors' discoveries reveal that by analyzing exchange histories and utilizing users' provided data to Bitcoin trades, it may be possible to recognize criminals. The probability of identifying criminals through this means is extremely low as most criminals do not give their real identity to Bitcoin exchanges.

2) Stability

Due to high volatility, the market capitalization of the cryptocurrency industry is not stable. Many companies and banks reject integrating cryptocurrency into their payment systems because of fear. This fear is due to the sharp price changes of cryptocurrencies and difficulty in establishing a value. The right regulations could minimize the volatility of cryptocurrency and make cryptocurrency appealing to the public.

3) Regulation

Regulation is a major concern with cryptocurrencies. The emergence of cryptocurrencies has been a disruption for the government regulatory systems across the globe (Sharma, 2023).

Governments have tight regulations and control over traditional banking systems which is not currently the case for the cryptocurrency framework. It has however been noted that the success of cryptocurrencies will depend on the way the regulatory framework works (Sharma, 2023).

In addition, given the rise in interest and adoption of digital transactions and payment systems in almost every sector, and with cryptocurrencies gaining recognition worldwide, governments have, as well, expressed interest in developing policies and regulations that will allow this novel currency to expand. This would not only satisfy the privacy of the transactions but also allow government regulatory systems to mitigate the risks that come with the technology.

2.4 Digital Financial Services

While usage of digital financial services (DFS) has been growing rapidly over the course of the last five years, led primarily by the adoption of MNO wallets, much of the potential remains untapped. Overall uptake of DFS remains rather low, when compared alongside neighboring Kenya and Uganda. According to Findex, only 31 percent of adults owned a mobile money account in 2017. MNO wallets are as of now advertised by the two fundamental operators, MTN and Airtel, which are basically confined to fundamental exchanges. MTN leads the way in terms of spearheading further innovation, partnering with the Commercial Bank of Africa to offer mobile savings and short-term loan service –yet uptake of related services has been limited. There is thus ample room to grow MNO wallet adoption, increase transaction volumes/usage and expand the existing service offering, which could provide a meaningful way of boosting financial inclusion, but also facilitate the expansion of other e-transactions that rely on digital payments such as e-commerce. However, poor consumer awareness and weak merchant acceptance emerge as two critical issues that continue to hamper greater usage. Banks are only just starting to enter the digital payments sector and have been slower to embrace digital channels and support innovation. Several banks have, however, started offering services in mobile and online banking, and upgraded their core systems to provide open APIs that enable the development of more innovative products and services. While usage of related services continues to grow, it is yet to gain scale. As an example, in late 2016, there were supposedly one million account holders utilizing mobile banking services, performing a couple 4 million

exchanges annually. Moreover, although the number of ATMs and card-reading points of service has grown, a mere 5 percent of adults reportedly owned a debit card in 2016. While existing DFS regulation and payments infrastructure, including the deployment of an integrated payment processing system and pending introduction of a national payments switch, have helped level the playing field and boosting interoperability between financial service providers (FSPs), a handful of restrictions specific to banks continue to hinder banks' ability to fully participate and compete with other "non-bank" FSPs.

3. Research design.

This research is informative as it tries to shed light on the challenges that blockchain are facing despite there long term advantage towards the development of financial institutions in Rwanda. This area of research has few articles and papers, nevertheless, we have managed to collect data from National Bank of Rwanda; several references have been consulted in addition to compile important information related to this topic. Descriptive and comparative analysis have been used as approaches in our methodology during this research and then, we come up with some findings we are about to discuss.

4. Conclusion

The introduction of blockchain technology has had a significant impact during the COVID-19 emergency in Rwanda, empowering parts of the economy to proceed to work online and through remote working. In other ranges, digital solutions were required to ensure healthcare laborers, and treat and care for patients. There presently needs to be a combination of these advanced progresses over businesses to build up the establishments for a more profound advanced change and a solid and maintained financial recuperation. Thus it is consider the advances made amid COVID-19 to be a portion of a long-term trend towards a savvy economy characterized by independent frameworks, increased forms, carefully spoken to resources, predictive frameworks, and interconnected gadgets that make unused commerce openings and efficiency improvements.

Our research has convinced us that government action is needed to aid the post-COVID-19 recovery. Focusing on blockchain implementation and efficiency solutions in order to accelerate the move to a smart economy and, in the process, accelerate economic growth for prolonged prosperity.

5. Recommendations

1. Place blockchain solutions as the core of the recovery strategy as investing in FinTech generates greater-than-average returns for the economy.

2. Boost infrastructure investment. The establishment of a keen computerized economy is a solid and reliable infrastructure.

3. Enable a digital recovery for all, not just the happy few targeted initiatives supporting

4. Double efforts to improve ICT skills and digital literacy. Ensure that specialists, companies and family units have the capabilities to gain from a digital economy.

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