Proof of Concept of Blockchain Integration in P2P Lending for Developing Countries

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Abstract. Blockchain is depicted as a promising technology for fintech notably in developing countries. That's why, it's important to be interested in it, so as to know how to realize these probables blockchain's benefits. It presents a diversity of choices that impact on results in various ways. Studies have focused on fintech services business models such as P2P lending, others on the blockchain impact on finance, some even particularized in the case of developing countries. In these areas, a massive penetration of mobile phones is noted. It is in this context that fits this present study. In this paper we study the feasibility of a P2P lending platform based on blockchain and adapted to developing countries. The main contribution made by this article is: we developed a protocol and a business model of Peer-to-Peer (P2P) lending suitable to developing countries and accessible via mobile phone. The protocol integrates a service against the diversion of objectives which is based on smart contract.

Keywords: Blockchain · Fintech · Developing countries · P2P lending · Smart contracts

1 Introduction

In this study, in order to achieve specific objectives, we will have to answer the following questions. Would we be able to settle choices and thus obtain an innovative combination? Would we be able to gauge the combination to identify where and how to act?

Indeed, the blockchain technology used in this study offers various choices combinations, if only for the chosen type, consensus, the content of smart contracts, the choice of blockchain for storage. However, these choices are guided by the expressed needs, it will take exploit its and adapt its to the targets in order to make them pertinent, innovative and ready to challenge the existing. Moreover, many financial sector firms invest in blockchain solutions [1].

Our needs in this study are in fintech's field, another motivation to do an analysis work, [2] business models that are not robust in a lending or financing environment could harm. Indeed, it is a question of realizing a proof of concept which aim of setting up a fintech services platform to do mobile P2P lending adapted to developing countries realities. It will be based on a blockchain technology. The objective is to experiment work based on the assumption that a combination based on Blockchain, Fintech, mobile money, P2P lending and developing countries well-analyzed can promote financial inclusion and lead to an innovative solution. This being the general objective, to be more precise the work aims to define a protocol and a business model that we will gauge by a SWOT analysis.

Given the desired aspect which is the reusability of our work in fintech and blockchain in general, a flexible approach will be adopted consisting in abstracting the needs and solutions before concretizing them with a P2P lending protocol and business model.

2   Approach and Structuring

In this part we describe the adopted approach which explains the structuring.
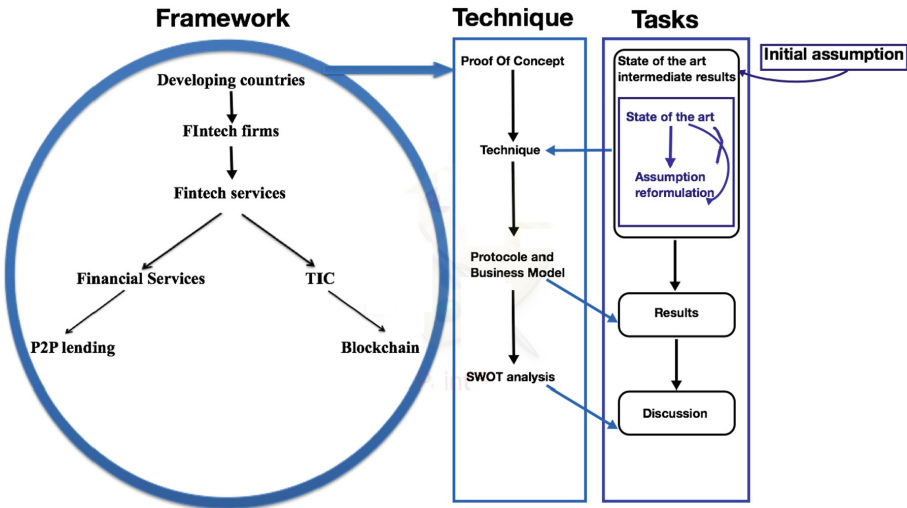

Fig. 1. Approach and structuring.

2.1   The Framework

To better workout our study, the framework is defined. As stated in Fig. 1, our target area is developing countries, we are interested in P2P lending services

and the core technology of our study will be the blockchain. So there is talk of offering fintech services adapted to the context of the developing countries and to use the blockchain as underlying technology of this. Hence, the targeted space, services and core technology are defined and it is important for the constituent elements of our technique.

2.2   Technique

The framework is circumscribed, we will describe the study's technique, it integrates into the Proof Of Concept (POC) more particularly to the technical feasibility. The objective is to realize a protocol and a business model adapted to the defined framework, we submit them recursively to a SWOT analysis in order to evaluate it, we stop the analysis once we obtain a satisfactory protocol.

This process will be taken into account in the different tasks that will be performed in this work.

2.3   The Tasks

Each step of the technique is either source or consequence of a task. Indeed, to achieve the technical feasibility part we will make a state of the art, we refer to this last to obtain the protocol. For every verification of our initial hypothesis part, we formulate again the hypothesis. Thus, we will progressively verify our hypothesis by attenuating it as and when we find results. The protocol and intermediate results will be our results. To discuss these last, we will do a SWOT analysis.

This section "approach and structuring", was therefore to give an idea on the philosophy behind the various points that will be addressed in this document.

3   State of the Art

Reviewing the literature to explore the concepts, assets and challenges is important to achieving the objectives.

3.1   Concepts and Definitions

The different concepts, taken individually and/or combined, have aspects that can influence the decisions and the orientations of our study. That's why it is important to browse some scientific papers treating them.

The relationship between these terms and concepts is that mobile money innovations are increasing rapidly in developing countries, where they could extend financial services to billions of unbanked populations [11]. [12] proposes blockchain as underlying technology for entrepreneurial models aiming financial inclusion by adopting the practices of unbanked people. Indeed, properties of integrity, resilience and transparency of blockchain technology cause it to arouse

Table 1. Definitions of concepts

Concepts	Définitions
Fintech	Fintech is the use of financial technology that describes an emerging sector of financial services in the 21st century [3]
Mobile Money	It is the use of cell phone technology to make financial transactions [4]
P2P lending	These types of fintechs allow individuals and businesses to lend and borrow among themselves [2]
Blockchain	Blockchain technology is a protocol for the secure transfer of money, property and information without the use of a third-party intermediary, such as banks or other financial institutions [5]
Consensus	It allow secure updating of a distributed shared state [6]. A consensus algorithm defines a set of rules to reach agreement on transactions and their order [7]
Smart Contracts	There are code form implemented on the Blockchain. They are based on predetermined factors and are autonomous and auto-executables [8]
SWOT	It is a method used to analyze and position an organization's resources and environment in four areas: strengths, weaknesses, opportunities and threats [9]
Loan motivation	It is the object that wants to acquire (or the service that wants to pay) the borrower. It is specified in the loan application
Financial inclusion	It is about access to financial services from sound and viable institutions at reasonable prices [10]

so much interest [13,14]. Given the promises and risks of such disruptive technology, many financial sector firms are investing in blockchain solutions [1].

To support this need to study our concepts combined, a proof of need is provided below.

3.2   Proof of the Need of Mobile P2P Lending Based on Blockchain in Developing Countries

In this part we will prove the need to use each of the concepts before attacking the need to elaborate the protocol. Remember that our geographical framework is developing countries.

Proof of the Need of Fintech Specifically P2P Lending Service: P2P lending platforms offer innovative solutions for developing countries that have difficulty obtaining traditional channel financing [13]. Henceforth, we can say that the P2P lending could promote the financial inclusion of these countries. Besides, by prescribing five sensitivities to undertake in the field of fintech based on the blockchain and reaching the unbanked population, [12] proposed the P2P network as a solution.

Proof of Need to Access Services via Mobile: In Sub-Saharan Africa, in 2019, mobile penetration has reached 76%, while less than 30% of people have a bank account [11]. In parallel, the use of mobile accounts is more common in these areas [15] (20.% versus a global rate of 4.4%) according to (World Bank, 2018). In addition, in developing markets, more than one billion people have a mobile phone, which can serve as a basis for the development of mobile financial services including payments, transfers, insurance, savings and credit [16]. So the target population is predisposed to mobile services.

Proof of the Need of Blockchain and of Protocol Development: Blockchain has attracted a lot of attentions, investments and developments within FinTech because it addresses two of the most risky aspects of Internet business: transactions and trust [17]. Let's start with the fintech expectations to show that we need to use blockchain as underlying technology.

Fintech faces increasingly demanding customers in terms of speed, ease of use, cost [3], security [12,18] and confidentiality [18] and a law to protect customers transparency and traceability [19]. These needs must be taken into account. In addition, security against theft [12] promotes the transition from cash to digital. Customer management is a challenge for fintech [2]. Note that, when we mention the law in this part we are referring to the case of WAEMU [19]. One of the technological innovations of financial services is the blockchain, which permits it to improve previous applications and deploy new applications that were previously uneconomic or impractical [3]. Indeed, in the field of banking and financial services, blockchain technology can simplify business processes and creating secure and reliable records of agreements and transactions [14]. However, for each of its expectations of fintech, its satisfaction may differ according to the type, consensus mechanism and business model chosen. So we can say that the blockchain could be the underlying technology of this service, however it would be necessary to define the adapted protocol to the needs.

4   Results

First, we define a business concept to achieve expected results. Then we present the latter which are a protocol and a business model allowing to make a P2P lending based on the blockchain in developing countries and accessible via mobile.

4.1   The Business Concept

A part of our hypothesis is verified. In addition, regarding the follow-up of the loan motivation to verify its compliance, this could be an added value to a P2P loan platform. Indeed, for its descriptive statistics for the dependent variables in the estimations [20] mentions Loan-taking motivation in the determinants of financial inclusion in Africa Review of Development Finance. Since this is a determining factor, the transparency of the Loan-taking motivation can encourage participatory financing or an investor to finance a loan.

Initial Hypothesis: A combination based on Blockchain, Fintech, mobile services and developing countries which is properly analysed can promote financial inclusion and lead to an innovative solution.

What is Done: We are starting from the target area (developing countries) to demonstrate the need to combine concepts and to develop a protocol and have announced an innovative approach: follow-up of the loan motivation to verify its compliance. Hence, we can give now the definition of our business concept. The business concept is a business idea that includes basic information such as the service or product, the target demographic group and an unique sales proposal that gives a company an advantage over its competitors [21].

Business Concept: We proof the need to offer to developing countries a blockchain-based mobile P2P lending service. We identify an innovative way to enhance its value. Our proposal is able to verify compliance between the motivation stated as the purpose of financing in general (of a loan in particular) and the use of the amount granted.

Hypothesis Reformulation: In the developing countries context, knowing that it is interesting to set up a P2P lending service based on blockchain technology provided that its protocol is well defined. An analysis work would allow us to adopt a business model and choose the characteristics of the suitable blockchain in accordance with our expectations.

4.2   Protocol and Business Model

We make choices that form the defined protocol. It is about of considering the varieties of each factor and choosing the most suitable for our business concept.

The Blockchain's Type for the P2P Lending: There are three types of blockchain named public, private and federated. The choosen type is private blockchain. Its low transaction costs are adapted to the low incomes characteristic of the target area. Private blockchain is adapted to laws such as those of WAEMU. Indeed, users are identified in the blockchain network with more control [8,13,22]. It has good throughput and maintenance and has a low latency [13], which is very important because of the increasingly demanding users. However, it reintroduces a single point of failure, which can compromise the underlying data [8] and provides low system confidence compared to other types of blockchains.

Choosing a type reduces the range of consensus mechanism choices because not all consensus mechanisms can be used in a private blockchain.

The Blockchain's Consensus Mechanism for the P2P Lending: According to the Table 1 (A comparison of popular blockchain consensus mechanisms), consensus mechanisms compatible with the blockchain private type are: Proof-of-Stake (PoS), Proof-of-elapsed-Time (PoeT) and variations of PBFT [6]. Now, security threat is more serious in Proof-based Consensus algorithm such as PoS and PoeT compared to Vote-based consensus algorithm such as variation of PBFT [23]. In PBFT transactions are confirmed immediately and have a high throughput. The scalability in terms of number of customers is high. It is not a source of energy waste. It should be noted that the target area has energy problems. In addition, with these mechanisms the nodes are identified which is in phase with the requirements of the law. The tolerance towards opponents is certainly 33% of the voting power compared to others as the proof of work which is 25% of the computing power, but this is to be taken into account. The scalability in terms of number of nodes is low. Hence, we choose variations of PBFT.

Borrowers-Investors Matching and the Loans Interest Rate: There are various model to the meeting of borrowers and investors. In a diffused model the platform collects funds from various investors for various loans taking into account guidelines. This is a financial risk management strategy. In addition, the time required to obtain the borrowed amount is shorter. The other model is the direct model where the investor decides how much to lend to the borrower [24]. Given the low incomes characteristic of developing countries, it is very likely that loans requested will be motivated by immediate needs, hence the importance of the short time between the request and the granting of the loan. That's why we choose the diffused model. For greater flexibility, interest rates must be able to vary from one loan to another. For loan interest, in view of the fact that the online P2P credit market is not yet very developed in some developing countries, we have chosen a model that takes this into account. Indeed, the model chosen is such that investors set their maximum interest and borrowers their minimum interest and the platform will match the interest taking into

account other elements such as financial risk. The other models are: [24] reverse auction and automatic matching.

Our model is based on customer (borrowers and investor) instructions.

Linear Regression as a Credit Scoring Models: On the one hand, [25] proposes neural network credit scoring model and compared it with the Logistic Regression to evaluate borrowers' creditworthiness. On the other hand [26] classifies some scoring models. By merging the results of [25] and [26], the percentages of correctly classifying a bad customer is recorded in the Table 2 below.

Table 2. Models and their percentages to correctly rank a bad borrower

Models	% ranking a bad borrower	Reference
Linear regression model	87.5	[26]
Poisson model	81.8	[26]
Negative binomial II model	80.6	[26]
Two step procedure	79.8	[26]
Discriminant analysis	78.0	[26]
Neural Network	74.38	[25]
Logistic Regression	61.03	[25]
Probit model	54.1	[26]

To minimize the risks, we chose the linear regression model because. It is the one with the highest percentage. Identifying a bad payer is very important because P2P lending attracts high-risk customers.

Smart Contracts Against the Misuse of Objectives: The absence of an intermediary is one of the greatest advantages of the blockchain, the role played by these trusted third parties should not be overlooked, hence the interest given to consensus. Smart contracts are attractive in many scenarios, particularly those that require money transfers to comply with certain agreed rules [27]. Through smart contracts, various actors can collaborate by pre-defining their logic. Indeed, smart contracts are "if then" type programs, they are executed automatically if their conditions are verified. Thus, to monitor the amount lent to ensure compliance between expenses and the financing motivation, a smart contract could be used to target the accounts to which the amounts will be transferred. In this case, instead of giving the amount directly to the borrower, it will be directly to the accounts of the service provider or the acquisition of which is designated as the reason for the financing. Before answering the how of such an action, let us first specify its interest.

The Interest: Using a smart contract to verify compliance between the stated motives and the use of the amount would be useful for financing requiring proof of expenditure or verification of the acquisition of the good or service designated as the purpose of the financing. Indeed, to generalize the statements of [8], smart contracts provide an elegant way to link accounting, reporting and monitoring of the amount financed. This proven need, let's pass to the analysis and design.

Analysis and Design: Such work requires access to the service supplier's account but also a way to verify the veracity of certain documents. To set up a smart contract to manage this, a few design templates may be requested (Table 3).

Table 3. Useful smart contracts design pattern

Useful design pattern	Solution	In the study context
Oracles	Oracles are contracts which are the interface between contracts and the outside, it can be queried from other contracts. In practice, contract queries an oracle instead of querying an external service; and when the external service needs to update its data, it sends a suitable transaction to the oracle [27]	Ideally all actors would be accessible via the platform offering the service. However, this is not always the case. To use external supporting documents, this contract may be called
Time constraint	Implement time constraints to specify when an action is allowed [27, 28]	If the expenses in accordance with the reason are diverse and their compliance is achieved only if some or all of these expenses are proven. A constrained time will be used. [28] It should also be noted that this one has vulnerabilities described by (Atzei et al. 2017)
ChecksEffects-Interaction Pattern [29]	It allows to follow a recommended functional code order, in which calls to external contracts are always the last step, to reduce the attack surface of a contract manipulated by its own external contracts [29]	To manage vulnerabilities related to contract calls in contracts
Math	Contracts using this model encode the logic that protects the execution of certain critical operations [27]	For example, to avoid subtracting a value from a balance when there are not enough funds in an account [27]. This constraint is useful for tracking an amount
Emergency Stop (Circuit Breaker)	Incorporate an emergency stop function into the contract can be triggered by an authenticated party to disable sensitive functions [29]	To bypass the immutability of the blockchain [29]

Thus we know the patterns that will be used in the solution against the misuse of objectives. These results allow us to verify our reformulated hypothesis. However, in order to assess the relevance of our results, we will discuss them and take the opportunity to identify some ways to improve our results.

5   Discussion

Our results are obtained by comparing the various characteristics and making choices. Now we will gauge the combination of these various characteristics through a SWOT analysis.

Strength of Our Combined Choices: Cost per transaction and latency are low; throughput and maintenance are good [13]. Users are identified within the blockchain network with more control [8,13,22]. The platform matches borrowers and investors according to criteria such as scoring, interest rates. The willingness of stakeholders on the reasons for the loan is taken into account. For the low trust in the system that is relative to the private type: the use of smart contracts will strengthen trust in the system.

Weakness of Our Combined Choices: Scalability in term of number of nodes is low (maximum tested is 20). Malicious tolerance is 33% of voting power. Other weaknesses include: the use of oracle to validate data provenance and run smart contracts.

Opportunity of Our Combined Choices : it offer better compliance with laws such as those of the WAEMU in terms of identity management and better privacy [22]. Transactions confirmation are immediate and have high throughput and high scalability in term of number of clients. Borrowers get money in a short period of time [24]. The probability that each borrower will receive their request for funds is high [24] and diversification of investment is good. The interests of the borrower and the investor converge as a result of the matching of interest rates. The platform promotes financial inclusion and monitors the use of the loan amount.

Threat of Our Combined Choices : there is the threat of data immutability where the pool of participants is small. Private blockchain reintroduces a single point of failure that can compromise the underlying data [8]. The use of oracles can lead to conflicts of interest over data sources.

Our results lead to a Proof of Concept boosting blockchain-based P2P lending in developing countries.

6   Conclusion

The contribution of this study focus on a service, P2P lending, which is an indicator of financial inclusion and on the blockchain. Our starting assumption

was: "A combination based on Blockchain, Fintech, mobile money and developing countries properly analysed can promote financial inclusion and lead to an innovative solution".

We verified the hypothesis and consequently, we made a proof of concept materialized by a protocol and a business model for the implementation of a P2P lending based on blockchain technology and adapted to developing countries and accessible via mobile. An approach was defined and used to achieve the results. A business concept with an emphasis on managing the misuse of resources is defined. An analysis and design based on the smart contract of this aspect has been done.

Once the feasibility has been proven, future studies may contribute to each element of choice, taking into account our SWOT analysis.

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