Blockchain and Smart-contract: a pioneering Approach of inter-firms Relationships? The case of franchise networks

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Keywords:

Blockchain, Smart-Contract, Transaction cost, Network, Franchise

JEL codes:
D86, L14, L81, O33

Working Paper

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The case of franchise networks

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1. INTRODUCTION

The blockchain technology is a disruptive technology, also called Distributed Ledger Technology (DLT) (Antonopoulos, 2017). A blockchain is a distributed ledger in which information is stored in a definitive and secure way using cryptography. More precisely, a blockchain is a ‘trustless’ distributed ledger, ‘trustless’ because they do not require third-party verification (i.e. trust), but rather use high-powered crypto-economic incentive protocols to verify the authenticity of a transaction in the database (i.e. to achieve consensus) (Davidson et al. 2018).

The blockchain can be used for any form of register, inventory and exchange of assets, including all areas of finance, economics and money, durable goods (material goods) and intangible assets (votes, ideas, reputation, intent, data and health information) (Bartoletti and Pompianu, 2017). The use of blockchain technology allows multiple applications in all segments of the company involved in monetary, financial and market transactions (Swan and De Filippi, 2017).

The subject of this paper is to analyze the possible impact of storing contracts between parties into blockchains, more specifically contracts between firms, for example franchisees and franchisors. This kind of contracts are *smart-contracts*. These contracts, stored in a blockchain, also have the characteristic of being able to be triggered automatically (Bashir, 2017).

Thus, whereas a traditional legal contract defines the rules of an agreement between several parties, a smart-contract goes further and sets these rules in a Blockchain while ensuring the transfer of an asset (whatever it may be) when the contractual conditions are met. Many contractual clauses could be made self-executing, self-enforcing, or both. Smart-contracts are always and necessarily deterministic, meaning that all possible outcomes of the contract (including penalties for its breach) must be explicitly stipulated in advance (Malkovský, 2015).

This paper will seek to show that the development of blockchains and smart-contracts significantly modifies the firm's contractual analysis, inter-firm relations and, in particular, the very definition of the franchise agreement and the development prospects of these networks. The paper is organized as follows. Section 2 introduces a more detailed analysis, and necessarily a little technical, of the concepts of blockchains and smart-contracts. Section 3 presents possible changes in the firm's contractual theory associated with the introduction of smart-contracts, section 4 some examples of blockchain technology applications. In section 5 we present some promising perspectives linked to a widespread use of smart-contracts in franchise networks. Section 6 concludes and questions the challenges and limits of smart contracts and blockchains.

2. BLOCKCHAIN: WHAT ARE WE TALKING ABOUT?

2.1 Blockchain for crypto-currencies

The blockchain technology is a disruptive technology, also called Distributed Ledger Technology (DLT). A blockchain is a distributed ledger in which information is stored in a definitive and secure way using cryptography. Until now, applications in crypto-currency are the most common and historically the first, we thus start with a brief description of one them.

Information to be stored is gathered into *blocks* linked to one another. This information can be very diverse: cryptocurrencies transactions such as in the case of bitcoin, encoding of images for future claim of Intellectual Property, contracts between parties… Once stored in a blockchain, a block cannot be modified anymore (principle of immutability). A blockchain is a database, but the main innovation is that the storing process is fully decentralized: the database is replicated on the nodes of a network of (possibly) untrusted computers without intervention of any trusted third party. Size of this computer network may vary, up to several tens of thousands. The challenge in inventing such a technology was clearly to design secured consensus protocols, ensuring that all computers can agree on the information stored in the blockchain. Many consensus methods are still currently under investigation (Seang and Torre, 2018), but only one has been largely tested: the Proof of Work (PoW) mechanism. This mechanism is the backbone of the blockchain of the Bitcoin since 2009 and it works as follows (Antonopoulos, 2017). Some nodes of the network, called miners, gather information from all other nodes wishing to store transactions in the blockchain. Miners then check the information they gathered. In the case of Bitcoin, miners will check among other things that a payment is valid: the debtor has sufficient funds to honor his payment. Then, miners enter a competition to be the first to include the information he checked into a block, and include this block into the blockchain. The winner is rewarded by a bounty in crypto-currency. The competitive process amounts to solve a complex cryptographic problem, in which miners have no other solution than randomly drawing some numbers in order to find one of them satisfying a certain condition. This computational task requires energy to run computers, hence the name *Proof of Work*. Typically, it takes 10 minutes to miners of the Bitcoin network to fulfill the required condition, despite huge investments in dedicated computer equipment. In this process, the miner validating the next block to be included into the blockchain is indeed drawn almost randomly (although a higher computational power will of course increase the probability to be the winner). Once validated, this block will be considered definitive (immutable) only after a certain number of blocks have been added afterward.

2.2 Blockchain for smart-contracts

The subject of this paper is to analyze the possible impact of storing contracts between parties into blockchains, more specifically contracts between franchisees and franchisors. This kind of contracts are called *smart-contracts*. In addition to the fact that these contracts are stored on a blockchain, they also have the functionality to be able to trigger automatically (Antonopoulos and Wood, 2018). Let us give the example of a contract of carriage between an airline and a passenger. After purchasing a ticket, the transport agreement is stored on a blockchain in the form of an executable code. The contract of carriage defines the rights and duties of both parties. All these rules are encoded as executable computer programs, mainly under the form *"If ... then ... else"*, in other words, if a certain condition is met, then a certain action can be triggered, and if not, this will be another action. Now assume that the passenger's flight is significantly late and one rule of the contract addresses this case with a partial or total refund to the passenger. We know that most passengers do not claim for this refund, due to the complexity of this request. But in the case of a smart-contract, refund could be automatic, provided the contract receives the information of the aircraft delay through e.g. a third party specialized in this task (such a third party is called an *oracle*). This automated execution would certainly alter the contractual relation in the case of transport agreement.

Currently, the most common platform for smart-contracts is Ethereum. Ethereum is a public blockchain (open to anyone who wishes to join) that can support advanced smart-contracts, by means of powerful dedicated programming languages to write customized contracts. Many blockchains associated with a crypto-currency – where the blockchain is firstly designed to store transactions of this currency – also have this feature of storing smart-contracts in general, instead of only transactions. This is the case of the blockchain of Bitcoin, but the associated programming language is not powerful enough to allow for the encoding of arbitrary complex contracts. Ethereum was indeed invented to circumvent this limitation. The terms of a contract between at least two parties are first formulated in a programming language. Then, this code is transferred to a blockchain. It will self-execute automatically when any condition encoded into the smart-contract is met. Once on the blockchain, smart-contracts may interact with one another, through the exchange of communications called *transactions*. The interest of the blockchain storage is its property of immutability: once in the blockchain, one party cannot prevent the self-execution of the smart-contract; neither can she alter its content. It must also be noted that a blockchain of this kind is usually associated with its own proper crypto-currency. The one associated with Ethereum is called *Ether*. Although these currencies can also be used as means of payment and subject to speculation, they are primarily designed to enable the whole system to operate. Ether is used to pay for *gas*, a unit in which the cost of execution of the programmed version of the contract is measured and paid. This *execution fee* is paid (in Ether) in advance by the contractors, and benefits to some network's nodes, also called miners as in the Bitcoin case. When successful, a miner receives a reward for the validation of contents to be included into a new block, plus some fees coming from the execution of the smart-contracts. Each operation of a programmed smart-contract consumes a certain predefined amount of gas. In the end, if the contractors paid for a sufficient amount of gas, then contract will be fully executed (possibly remaining gas being refunded to contractors). If not, all operations carried-out will be cancelled and no part of the contract will be executed.

Note that the execution of a smart-contract may require an information coming from outside the blockchain. In the example of the contract of carriage, if it happens that a delay is actually noted, this information will have to be delivered to the smart-contract. Such services, which provide data to smart-contracts, are called *oracle*. An oracle is stored in the blockchain as a usual smart-contract, and can thus interact with any other smart-contract. Clearly, an oracle is a third party and as such, must be reliable. Even then, mechanisms have been developed to ensure trust between parties. Some companies are already offering oracle services (*Oraclize, Reality Keys from Social Minds*...). This is an important feature: the information can come from automatic devices, including those on the Internet of Things (IoT): cameras, RFID readers, sensors in general…

3. BLOCKCHAIN AND SMART-CONTRACT: A REVOLUTION FOR THE CONTRACTUAL THEORY?

According to contractual theory, any relationship between agents is costly (drafting of the contract, control of agents, etc.) and parties face asymmetries of information: moral risk (contractors are not fully informed about their respective behavior) or adverse selection (uncertainty about the intrinsic characteristics of contractors). Faced with these imperfections, the theory of contracts offers different answers. Transaction cost theory considers that certain organizational forms are more likely to limit transaction costs. For example, the firm exists because the internalization of transactions makes it possible to substitute a single long-term contract for a series of short-term contracts concluded on a market. In another contractual context, incentive theory presents the franchise system as an organization that can align the interests of agents and thus limit information asymmetries. Indeed, the franchisee's residual claimant status (who retains all profits after remuneration of the franchisor), introduces an incentive to effort and the ownership of the outlet is a mechanism that can align the interests of the franchisee and the franchisor.

With perfect rationality, complete information and free transactions, all agents can commit to complete contracts, so there is no need for trust. However, if the information is imperfect, the transactions are not free, and trust in the contract is lacking. From this point of view, smart-contract (integrated into a blockchain) can be seen as a new mechanism of transaction coordination and opportunism control to extend that blockchains eliminate the need for trust by using crypto-enforced execution of agreed contracts through consensus and transparency.

From the contract theory point of view, one of the main advantages of using smart-contracts is their ability to reduce significantly transaction costs, *i.e.* costs of negotiating, drafting and complying with a contract. The comparative economic efficiency of blockchains can be understood as an extension of Coase (1937) and Williamson (1985) transaction cost analysis with respect to the comparative efficiency of companies and markets.

Williamson (1985) considers that a hierarchical organization is a way to control opportunism in the presence of limited rationality and high asset specificity, by internalizing the transaction that is the source of opportunism. As a firm, "(b)lockchains can also control opportunism, but they do so by harnessing market mechanisms and internalizing them within a closed and guaranteed payments system" (Davidson et al., 2018). A similar claim is that blockchain platforms can minimize opportunism by a combination of radical public transparency coupled with cryptographic enforcement and execution through smart-contracts and their agents (e.g. Decentralized Autonomous Organization) (Swanson 2014).

We can thus consider that blockchain based platforms for coordinating economic activity may compete with hierarchies to overcome opportunism. More precisely, blockchains can mitigate opportunism through incentives and crypto-economic mechanisms at relatively low transaction costs, and then be more effective in terms of minimizing transaction costs than hierarchies as a coordination mechanism. From a transaction cost theory perspective, opportunism can be reduced if transactions are managed into a blockchain rather than on a market or within a firm.

In another contractual context, Alchian and Demsetz (1972) proposed an alternative theory of transaction costs focusing on monitoring production costs in teams. For Alchian and Demsetz, the firm is characterized by teamwork, led by a central agent. From this point of view, smart-contracts can offer a new approach of transactions coordination to the extent that blockchains are defined as an innovative centralized control model.

The Williamson and Alchian and Demsetz models of the firm both provide a theoretical reason to believe that blockchain technology could challenge the comparative efficiency of firms, as presented by contract theory, and offer a new alternative to coordination transactions.

According to the contractual theory, in particular the incomplete contract theory (Tirole 1999; Hart 2017), monitoring the performance of a contract by a third party is costly. As a result, there is a risk of ex-post opportunistic renegotiation (hold-up problem), which can reduce incentives for parties (e.g. two companies) to make specific investments and can sometimes encourage them to merge in order to conduct the transaction within the same firm.

In the relational contract (in a different contractual context), the external monitoring of a contract is based on the reputation that the contractors want to preserve, and the threat of stigmatization within their "network" (socio-economic)". The risk of losing their reputation encourages the parties to comply with the agreements, even without the intervention of an external third party. For this reason, relationship contracts are considered self-executing. “The blockchain technology provides economic system with a fourth type of economic relationship, the smart-contract” (Vatiero, 2018).

Table 1. Four contracts, four monitoring mechanisms

Contractual relationship	**Monitoring mechanism**
Firm	Authority
Traditional contract	A third trusted party (e.g. a court)
Relational contract	The socio-economic “network”
Smart-contract	The blockchain network

Vatiero, 2018

Unlike traditional contracts, where the parties can decide whether to fulfil their obligations, at the risk of assuming the consequences, smart-contracts cannot be breached. As a smart-contract codifies ex ante the responsibilities and obligations of the parties and executes them ex post with certainty, it leaves no room for interpretation of the terms of the contract. While in the literature, franchise networks have been defined mainly with the so-called traditional contract or less frequently the relational contract, we will show in the last section that many attributes of smarts-contracts are particularly well suited to the analysis of franchise networks.

Since smart-contracts make it possible to limit transaction costs, sharing and access to information, they are defined as an alternative mode of coordination to the firm and the market, the entire firm's contractual analysis and inter-firm relations must be reconsidered. Coordinating, through smart-contracts, agents within a firm or coordinating firms on a market (subcontracting, franchising, etc.) helps to limit transaction costs and information asymmetries. As a result, the explanation of franchising by contractual theory is also modified.

The theory of incentives justifies franchising as a mode of coordination that reduces control costs and encourages effort. Transaction cost theory defines franchising as a method of coordination that limits transaction costs, particularly if the specificity of assets is high. However, as we have seen previously, smart-contracts make it possible to achieve the same objectives. Is the effective distribution agreement that links an upstream and downstream firm still the franchise contract? Would not a smart-contract be more efficient, *i.e.* less expensive and more transparent?

4. WHICH PPLICATIONS OF BLOCKCHAINS?

In the field of possible applications of blockchain, the property of immutability is of great interest: once stored on the blockchain, the information is supposed to be tamper-proof and cannot be modified. This alone ensures a wide range of possible applications whenever this property is desirable. For example, governments or public institutions could use it to record land registries (experimented in Honduras and Georgia), the ballots of an election (under study in Switzerland), certified diplomas... In the field of intellectual property in general, blockchain can store some intellectual works (picture, texts...) in order to fix property rights with the creator before others can copy it. Note these examples do not even require the possibility of encoding smart-contracts: the issue is to store information reliably, as a ledger would.

Although the banking and insurance sector is the most dynamic in the application development, we want to mention here other promising sectors probably more relevant to franchising, insurance and supply-chain.

In the field of insurance, we can take the example again of flight delay insurance and the startup *Etherisc*. This startup is also developing smart-contracts of insurance to indemnify homeowner or farmers against inclement weather, including hurricanes. In such a case, a smart-contract has to obtain information related to climate conditions such as rainfall, wind, temperature. Such information may be obtained from meteorological agency's website, or any service of dedicated oracle (Giancaspro, 2017). Healthcare insurance is also a very promising area for blockchain usage. Healthcare is characterized by a whole ecosystem of contributors. Erroneous or duplicate records about patients lead to a costly administrative overhead. Blockchain technology can help gathering this information, while cryptographically securing private patient data. This is the case for example of the MedRec project currently developed by MIT (MIT, 2018). In this project, Electronic Health Records (EHRs) are not stored on a blockchain, but accessible through blockchain-recorded smart-contracts, containing pointers to relevant information outside blockchain (*off-chain*). As a last example, let us mention the B3i (for *Blockchain Insurance Industry Initiative*, see B3i 2018) consortium formed in 2016 by some of the biggest names (AXA, Allianz, Generali...) in the insurance area. In 2017, the consortium has launched a prototype of smart-contracts for specific cases of reinsurance due to catastrophe insurance (reinsurance protects insurers when large numbers of claim occur at the same time, typically during some disaster). Reinsurance contracts are recorded as smart-contracts. When a natural event occurs, the smart-contract evaluates numerous data sources and the computation of payouts to different parties is automated.

Another very promising field for blockchain application is the supply chain. Blockchain technology can address the central issue of traceability, while permitting processes that could be more cost-effective and efficient. Maersk and IBM have recently (august 2018) presented a blockchain-based platform called TradeLens[1], based on the blockchain framework Hyperledger Fabric, which main participant is IBM. Using TradeLens, multiple trading partners can share a single view of any transaction concerning a specific shipping, without compromising privacy or confidentiality. Almost 100 participants have agreed to participate in the project, including port and terminal operators, customs, others container carriers... In a similar way, Europe's largest retailer Carrefour has also adopted a blockchain-based solution to enforce traceability in the food

[1] https://www.tradelens.com/

supply chain. Currently limited to a few products, Carrefour is planning to deploy it across all its fresh products lines in a near future. Carrefour used the IBM Food Trust[2] system, which allows participants to share information on how products are grown, processed and shipped, from growers toward retailers. Once again, in the field of the food supply chain, Ernst&Young in collaboration with the startup EzLab[3], developed the so-called *Wine Blockchain*, used to certify the quality and origin of wines made in Italy. Thanks to a secured barcode on the wine bottle, a customer can get information on its own bottle. This information is stored on the Ethereum blockchain, interactions with the customer being possible thanks to a smart-contract. This application, allowing the customer to access information about the product throughout its entire delivery process, is of prime interest in many sectors: luxury products, pharmaceuticals, mechanical or civil engineering... Blockchain would here be a new tool to fight against counterfeiting.

5. BLOCKCHAINS AND SMART-CONTRACTS: NEW AND PROMISING PERSPECTIVES FOR FRANCHISE NETWORKS

Based on the definition and applications of Blockchain technology and smarts-contracts on the one hand and their influence on contract theory, we can draw different lessons for a renewal of the analysis of franchise networks and their management.

Thus, without going so far as to predict the short-term disappearance of the franchise contract, we propose to develop an argument in favor of increased use of smart-contracts in franchise networks, particularly at the supply chain level. Whatever the company network in which we are interested, the immense potential of blockchains, defined as decentralized databases, lies in their ability to store a large amount of information, in a transparent way that effectively limits information asymmetries between participants.

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[2] https://www.ibm.com/blockchain/solutions/food-trust
[3] https://www.ezlab.it/

5.1. Supply chain

The literature, more professional than academic, is beginning to focus on the beneficial effects that the use of smart-contracts and blockchains could have on the management of firms and firms networks. We can identify different potential positive effects of smart-contracts drawn up within or between firms compared to traditional contracts (Mazero and Sentell, 2019).

(i) Smart-contracts eliminate the need for intermediaries and allow for transparent and direct customer relationships.

(ii) The elimination of intermediaries eliminates additional costs, allowing companies and their customers not only to interact and transact directly, but also to do so with minimal or no transaction fees.

(iii) Based on trust, smart-contracts allow commercial agreements to be automatically executed and applied. Moreover, these agreements are immutable, one of the most interesting properties of smart-contracts in their application to contractual relations between firms

(iv) All contractual transactions are recorded in chronological order in the block chain and are accessible with the complete audit trail.

(v) If companies are not dependent on a third party, no one or entity has control on the firm. These decentralized contracts mean that even if an individual leaves the blockchain, the network will continue to operate without loss of data or integrity.

(vi) Since smart-contracts are stored in blockchains, all network members validate results. Therefore, no one can defraud by disclosing other people's data, as all other participants in the blocking chain would notice this.

We assume that all these positive effects are applicable to franchise networks. In particular, franchisors and franchisees are interested in a more transparent and reliable supply chain. Indeed, the research, negotiation and execution of supply contracts may not meet expectations, which may be detrimental to the franchise relationship. The success of a franchise system lies in the ability of the network's outlets to provide high quality products and services in the most efficient and sustainable way possible, thus ensuring brand preservation. To achieve this, the network must have an effective supply chain. A failed supply chain – not to deliver products on time to outlets and to provide defective products to consumers – can have consequences in terms of the performance or even sustainability of the franchise network.

5.2. Brand-name

Another sensitive point for a franchise network is the sharing of sensitive information between franchisor and franchisee, in particular in terms of know-how specific intangible assets, which are characteristic of the brand and a source of added value for the network. These assets have to be protected. Parties of a smart-contract must be invited and validated before participating and contributing. Then, the blockchain can provide this protection by guaranteeing to franchisors that only authorized agents or entities have access to information relating to such know-how, once it has been codified. In general, blockchain technology has the ability to "filter" access to information, in this case the franchisee members of the network.

5.3. Monetary Provisions

The execution of a contract in a blockchain eliminates intermediaries, which allows for self-executing contractual provisions, as long as such provisions are included in a smart contract, characterized by automatic triggering (Bashir, 2017). This is particularly the case for monetary clauses in franchise networks, fees and royalty. The payment of fees may be made automatically, in accordance with the provisions of the contract (on a given date, depending on a level of turnover or sales volume).

In the longer term, it is possible to consider that franchise networks may use crypto-currencies for fees and royalties, in order to secure the payment, make it more transparent and traceable.

5.4. Market

As mentioned above, smart-contracts allow for transparent and direct customer relationships. Widespread use of the blockchain in franchise networks, and in particular an *oracle*, could also provide access to more reliable information regarding market conditions. As mentioned above, an oracle is stored in the blockchain, is presented as a third party of the contractual relationship characteristic of a smart-contract.

In the case of franchise networks, an oracle could provide certified, and therefore reliable, information on market characteristics and developments, in particular on consumers and competitors.

6. CONCLUDING COMMENTS: PERSPECTIVES AND CHALLENGES

This paper was interested in the analysis of blockchains applied to inter-firm relationships, in particular the franchise networks. Our problematics led us to define blockchain technology and a particular type of contract stored in blockchains, smart-contracts. This new type of contract naturally questions the theory of contracts and its conception(s) of transactions, information asymmetries, the firm or inter-firm relations.

To better understand the challenges of blockchain for franchise networks and identify opportunities for implementation in these networks, we focused on some applications of this technology (supply chain or insurance). We have identified different areas of implementation of blockchain technology to franchise networks that could improve their management and therefore their performance: the supply-chain, the brand-name protection, security and transparency in the payment of fees and royalties, access to reliable information *via* an oracle.

This paper is only the first step in a more ambitious research project to address the challenges of blockchain technology and smart-contracts for franchise networks. The second step is the validation of the relevance of our assumptions. We propose to conduct interviews, with franchisors and franchisees (initially French), in order to assess the positive effects of this technology on the supply chain, brand protection and efficiency in the implementation of the clauses of the contract, in particular monetary.

As with any new technology, it can be anticipated that the integration of blockchain technologies will raise a number of issues. Their very own properties induce risks and major challenges.

The first challenging property of blockchain technology is its transparency. (Cong et al. 2019) show there is a risk of collusive behavior among sellers sharing a blockchain, when the transparency property of blockchain allows sellers to observe one another's business activities. Under these conditions, we could be confronted with a form of hold up specific to blockchain: the use of shared information for individual purposes. In the same spirit, noting the possibility of information leakage during a trading operation which may result in copying or front-running one's trade, (Tevasold Aune et al., 2017) propose a method to solve this issue using cryptographic hash functions.

Another intriguing aspect of blockchain technology is its decentralization, and the resulting model of governance. Abadi and Brunnermeier. (2019) propose a game theoretic setup to highlight the role of writers and readers using blockchains as ledgers. The paper examines the choice between public vs. non-public blockchain, and its relation to coordination motive between groups of users: when this motive is sufficiently strong, blockchain may lower intermediaries' rents. Besides the cost of the Proof-of-Work consensus algorithm, authors also note discoordination inefficiencies due to the possibility of *forks*, when a blockchain gives birth to two versions that may later on coexist. Furthermore, decentralization incurs new costs, including infrastructure's costs to support the required computational power. (Walch, 2015) argues that the various risks associated with the transition to this new infrastructure make this technology unsuitable and in the end, possibly, more costly. More generally, the question of the cost of setting up a blockchain raises the question of its implementation in small organizations, for example a growing franchise network.

The impact of blockchain technology must also be considered from a legal perspective. Giancaspro (2017) considers different risks inherent to *smart contracts*. Automatic execution of these contracts present a risk of errors, possibly irreversible or at least costly to be corrected. The automatic and honest character that makes the strength of the blockchain can also be a weakness, especially when it comes to early termination of a contract or changing its terms. The notion of amendment is not very compatible with smart contracts. Numerous other issues are also noticed: compatibility with existing contracts, capacity of the contractors, and misunderstanding of contract terms written in a programming language... However, we must take into account the youth of the blockchain, the technology underlying smart contracts, and the enthusiasm of developers to find solutions to the obstacles that still stand in the way of their final adoption!

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