BLOCKCHAIN AND INTERNATIONAL TRADE: CURRENT APPLICATIONS AND FUTURE PROSPECTS

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Abstract

The objective of this study is to analyze Blockchain Technology, its current applications, and how international trade can benefit from its large-scale adoption. To this end, this research provides a brief historical overview of how transactions, in general, have evolved up to the present time, already shaped by globalization and the widespread use of the internet. With the development of new data systems and cryptographic techniques, combined with improvements in communication technologies—particularly the World Wide Web—Blockchain Technology emerged as a decentralized yet highly secure system that promises to reduce costs significantly, in addition to streamlining and simplifying various procedures. Thus, this study seeks to identify the areas in which Blockchain Technology is already being implemented beyond cryptocurrencies and smart contracts, and, finally, to examine how this technology has the potential to profoundly transform the way transactions are conducted.

Keywords: Blockchain. Cryptocurrencies. Smart contracts. Decentralization.

JEL Classification: G1; K1; E4; F3; G2

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BLOCKCHAIN E O COMÉRCIO INTERNACIONAL: APLICAÇÕES ATUAIS E PERSPECTIVAS FUTURAS

Resumo

O objetivo deste trabalho é analisar a Blockchain, suas aplicações atuais e de que forma o comércio internacional pode ser beneficiado por sua adoção em larga escala. Dessa forma, esta pesquisa apresenta um breve histórico de como as transações, em geral, evoluíram até chegarmos à época atual, já impactada pela globalização e pelo uso massivo da internet. A partir do desenvolvimento de novos sistemas de dados e de criptografia, aliados ao aprimoramento dos meios de comunicação, sobretudo da rede mundial de computadores, surge a Blockchain, um sistema descentralizado, porém altamente seguro, que promete reduzir custos significativos, além de desburocratizar diversos procedimentos. Assim, buscou-se identificar em quais áreas a Blockchain já vem sendo empregada, para além das criptomoedas e dos smart contracts, e, por fim, analisar como essa tecnologia tem o potencial de alterar profundamente a forma como realizamos transações.

Palavras-chave: Blockchain. Criptomoedas. Smart contracts. Descentralização.

Classificação JEL: G1; K1; E4; F3; G2

BLOCKCHAIN Y EL COMERCIO INTERNACIONAL: APLICACIONES ACTUALES Y PERSPECTIVAS FUTURAS

Resumen

El objetivo de este trabajo es analizar la cadena de bloques (Blockchain), sus aplicaciones actuales y de qué manera el comercio internacional puede beneficiarse de su adopción a gran escala. De este modo, esta investigación presenta una breve historia de cómo han evolucionado las transacciones, en general, hasta llegar a la época actual, ya marcada por la globalización y el uso masivo de Internet. A partir del desarrollo de nuevos sistemas de datos y criptografía, junto con el perfeccionamiento de los medios de comunicación, sobre todo de la red mundial de computadoras, surge la cadena de bloques, un sistema descentralizado, pero altamente seguro, que promete reducir costos significativos, además de simplificar diversos procedimientos. Así, se buscó identificar en qué áreas ya se está empleando la cadena de bloques, más allá de las criptomonedas y los contratos inteligentes, y, por último, analizar cómo esta tecnología tiene el potencial de cambiar profundamente la forma en que realizamos las transacciones.

Palabras clave: Cadena de bloques. Criptomonedas. Contratos inteligentes. Descentralización.

Classificación JEL: G1; K1; E4; F3; G2

1. Introduction

The prospects for the adoption and use of Blockchain Technology have become increasingly prominent due to the advantages it offers and the impact it has generated across various types of transactions, including those related to international trade, significantly reducing costs, time, and, above all, bureaucracy.

To understand how we have reached the current stage of this discussion, it is important to present a brief history of the evolution of international trade and the way transactions and negotiations have been conducted over time.

International trade originated in ancient times, when exchanges took place primarily among tribes and nomadic peoples through barter systems. As demand grew due to population increases and expanding human needs, an evolutionary process began that extended trade across new frontiers and forms of commercialization, ultimately leading to the emergence of money as a medium of exchange (Compiani 2015).

According to Weatherford (1999, p. 5), this development is also linked to the emergence of the banking system and the standardization of currencies. Throughout this evolutionary process, money ceased to circulate solely in physical form—which required the handling of large volumes—and gradually came to operate in electronic formats through payment cards and internet-based banking transactions.

Against this backdrop and considering the industrial and transactional transformations associated with globalization and advances in communication technologies, the processes involved in commercial supply chains have become progressively more efficient. As a result, geographical barriers have diminished, bringing people and cultures closer together and directly influencing the way international trade is conducted today.

The widespread adoption of the Internet is directly linked to this process, not only with regard to communication channels but also in relation to intermediation and sales activities, making the transfer and safeguarding of funds faster and more secure through the interconnection of banking and financial systems, without the need for the physical transportation of resources.

According to Soares (2018, 11), despite technological advances—particularly those associated with the Internet—financial transactions have not evolved sufficiently to become fully streamlined, providing the level of efficiency and the security standards required. As a result, the current system still relies on practices established centuries ago, such as requiring importers to obtain

letters of credit and other procedures conducted by third parties who are not directly involved in the commercial relationship, thereby contributing to the delays commonly observed.

Perhaps the central issue lies in the role of the guaranteeing intermediary and the trust placed in this support mechanism. In the traditional monetary system, states are responsible for issuing their currencies and implementing security measures to prevent counterfeiting. Likewise, credit card companies act as intermediaries in commercial relationships, ensuring that transactions are carried out transparently and correctly.

The consequence of these arrangements is reflected in what is expected from any transaction: trust in the system. If confidence in the intermediary is lost, the credibility of the entire system is undermined. In this context, when considering decentralized systems such as Blockchain Technology, the possibility of a breakdown in trust is still cited as one of the main obstacles to its large-scale adoption.

However, this uncertainty has diminished considerably as numerous countries and large corporations have come to recognize Blockchain as a secure technology with significant potential for development, as well as a strong capacity to reduce the costs and bureaucratic procedures inherent in relationships that depend on trust in intermediaries.

Therefore, this study seeks to explain what the Blockchain system is, how it is currently being used, and what the present and prospects are regarding its application in the field of international trade.

To achieve this objective, the research adopts a literature review methodology, drawing upon academic articles, information and reports from specialized media sources, as well as relevant legal doctrine and legislation.

Through this bibliographic analysis, it will be possible to assess the role and influence of Blockchain—and other technologies derived from this system—in the context of international trade. Furthermore, the study examines the prospects for the use of this decentralized system, which promises to substantially transform the way transactions are conducted in everyday economic activities.

2. Theoretical Review: The Blockchain System

When discussing Blockchain Technology, the term is often immediately associated with Bitcoin. This association is not coincidental, since the emergence of the famous cryptocurrency in 2009 represented the first practical application

of this technology in the monetary sphere. Consequently, many assume that the Blockchain system itself originated during that same period.

Nakamoto (2008, 8) proposed a system of electronic transactions that would not depend on trust in intermediaries. The model consisted of a peer-to-peer network, publicly recorded and protected through cryptographic mechanisms, preventing the alteration of transaction timestamps and records, thereby ensuring their immutability.

However, the concept of peer-to-peer computing—or distributed computing—predates 2008. Blockchain Technology is, in fact, the result of numerous research efforts and technological advances that, over time, culminated in its development and consolidation.

2.1. The Origin and Development of The System

According to Tapscott and Tapscott (2017, 25), as early as 1981 there were studies related to the development of cryptographic systems aimed at addressing privacy and security challenges arising from the anticipated expansion of the Internet.

This concern stemmed from the fact that there would always be vulnerabilities in the processes of storing and exchanging information, particularly due to the involvement of third parties, which exposed personal data to potential weaknesses in existing systems.

The invention of Blockchain Technology is generally attributed to Stuart Haber and W. Scott Stornetta in 1991. Their ideas regarding data cryptography were less ambitious than the applications observed today, reflecting a proposal to use the technology primarily as a digital document timestamping mechanism to verify authenticity.

The most well-known application of Blockchain Technology is the development of Bitcoin, the first cryptocurrency based on this system. Subsequently, Vitalik Buterin co-founded Ethereum, designing it as a new Blockchain platform with functionalities that Bitcoin did not provide.

Buterin also participated in the early development of Bitcoin but recognized its limitations and understood that Blockchain Technology could offer far more than a digital currency system. Consequently, he developed a more flexible architecture capable of supporting a variety of functions, including smart contracts, while maintaining a decentralized peer-to-peer network structure.

The launch of Ethereum in 2015 represents a major milestone in the history of Blockchain technology, becoming one of its most significant

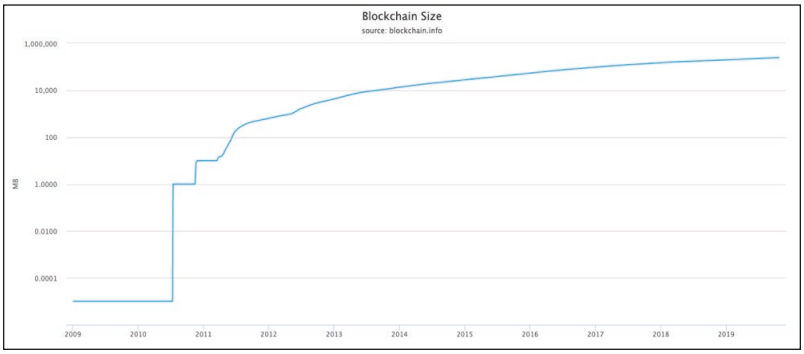
applications. Its extensive capacity to support smart contracts and execute multiple functionalities attracted a large number of develop pers, who formed an active community dedicated to its continuous improvement and expansion.

2.2 Growth and Adoption of Blockchain Networks

The history of Blockchain is relatively recent and remains under continuous development, as the system is still evolving and attracting an increasing number of individuals, governments, and businesses interested in the security, reliability, and transparency it provides.

Through the analysis of the graphs presented below, it is possible to observe the evolution and significant growth in the use of Blockchain Technology from two distinct perspectives. First, the volume of megabytes utilized within the Blockchain network for the certification and validation of processes; and second, the number of transactions per block, which is directly related to the extent of its use and adoption.

Figure 1 – Evolution of Blockchain Size in Megabytes

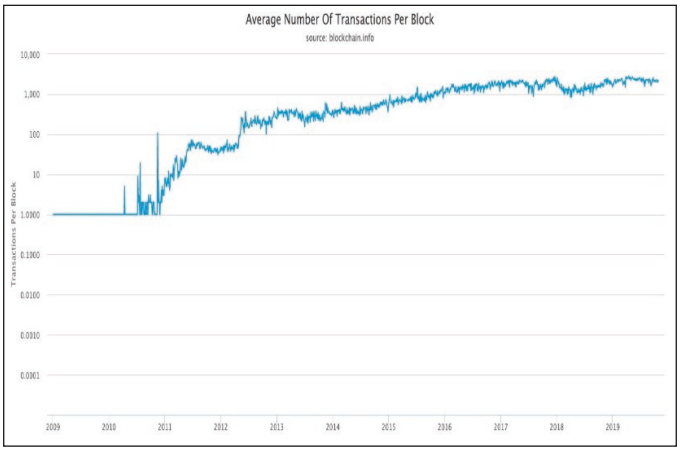


Source: Blockchain Luxembourg S.A., 29 oct. 2019.

In the first graph, it is possible to analyze the growth of the Blockchain network through the volume of megabytes utilized. It can be observed that between 2010 and 2011 there was continuous growth, with the Blockchain expanding at an average rate of approximately 1.18 megabytes every 24 hours, while the average block size was estimated at around 1.2 megabytes.

Consequently, this expansion is reflected in the increase in the number of transactions per block, as will be illustrated in the following graph.

Figure 2 – Average Number of Transactions per Block



Source: Blockchain Luxembourg S.A., 29 oct. 2019.

According to the graph presented, the average number of transactions per block is approximately 2,000, considering all possible operations. The total number of transactions recorded on the blockchain, according to Blockchain Luxembourg, reached 468,985,938 as of October 27, 2019.

3. Definition of Blockchain

Blockchain is a technological innovation that enables the creation of a data-recording system shared among users registered within its network and protected by cryptographic mechanisms.

According to Bernardi (2018, 15), Blockchain constitutes a structured set of data represented by peer-to-peer records that establish connections among participants through information stored in a series of encrypted and digitally signed blocks, thereby guaranteeing their authenticity and immutability.

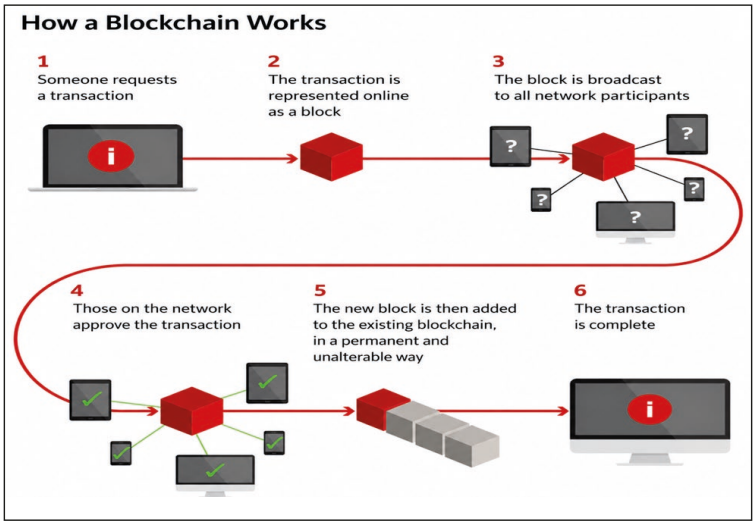
Rocha (2018, 39) explains that, in traditional systems, issues related to the security and validity of financial transactions are validated through the reliability and credibility of a trusted third party, typically a banking institution. In this context, Blockchain eliminates the need for such an intermediary, presenting itself as a more secure, cost-effective, and less bureaucratic alternative.

Giovanni (2019) compares Blockchain to a ledger in which all transactions are recorded. Its primary distinguishing feature is decentralization, since data are stored across a distributed network, functioning as a collective record.

Because these records are public and shared, they can be verified at any time, thereby enhancing transaction transparency. Information security is ensured through cryptographic mechanisms, creating a network of direct trust among participants and eliminating the role of intermediaries. Once entered into the system and validated by the network, a transaction cannot be canceled or modified, giving the records a permanent and immutable character (Giovanni 2019).

The following *Figure 3* graphically illustrates the operation of the Blockchain system. In general, information or transactions are grouped into a block, which receives a timestamp after being validated by the network. This verification process is performed by so-called miners, and once completed the new block is added to the existing chain of blocks, thereby finishing the transaction.

Figure 3 – The Operation of the Blockchain System



Source: Adapted from the Portuguese version of Times, PwC United States (2017), translated into English by the authors.

3.1. Current Applications of Blockchain

As previously mentioned, Blockchain technology is not exclusively linked to cryptocurrency transactions, although this remains its most widely recognized application. Today, there are numerous potential uses for Blockchain, as well as continuous improvements to the system, which have the capacity to significantly transform a wide range of processes.

Data storage represents one of the most important applications of Blockchain, given that the system is regarded as highly secure, providing robust protection for sensitive information while generating substantial savings in the management of data providers and infrastructure.

Currently, Blockchain is being implemented across a variety of sectors. In the healthcare industry, for example, efforts are being made to use the technology to store patient information, preserving medical records as immutable historical documents. Similarly, Blockchain has been applied to land registration and property demarcation in regions characterized by land invasions and inadequate formal record-keeping systems. In both cases, the technology ensures data integrity and immutability.

In the field of international trade, Blockchain is already being used in matters related to intellectual property, the identification of the origin and authorship of creative works, and the tracking of goods throughout supply chains. In this context, its role in combating counterfeiting is particularly noteworthy, as traceability becomes a key element in preventing the falsification and proliferation of illegitimate products, especially in the luxury goods, automotive, and pharmaceutical industries (Clark 2018).

However, the principal discussion centers on the development and implementation of Blockchain technology by the financial sector itself, which has already identified this innovation as a strategic tool for reducing transaction costs, streamlining traditional systems, and providing a security model based on highly reliable cryptographic networks.

With regard to applications directly related to international trade, in 2018 the first shipment of soybeans from the United States to China was completed with all stages of the process recorded on a Blockchain platform. Considering that goods in a logistics chain pass through multiple locations and involve numerous suppliers—thereby generating extensive documentation, records, and payments—and that documents may be lost during the process, Blockchain was introduced to make the operation more efficient. The technology enabled greater control, reduced operational risks, and simplified procedures, thereby increasing the security and reliability of the system (Hunt 2018).

Zemlianskaia (2017, p. 49) argues that banks and financial institutions have already begun investing in Blockchain technology and assessing its integration with existing infrastructures, both through specific applications and large-scale implementations aimed at the corporate sector. One notable example is Banco Santander, which estimated that the adoption of Blockchain technology could generate savings of approximately US$20 billion for the global banking system by 2020.

The possibility of conducting near-instantaneous global transactions, combined with transparency, decentralization, privacy, and cost reduction, represents only part of the advantages associated with Blockchain Technology. Nevertheless, Zemlianskaia (2017, 51) emphasizes that it is still premature to speak of its widespread implementation. The coming years will be decisive for its consolidation. Rather than constituting a complete revolution, Blockchain is likely to represent a significant transformation in the way banking transactions—and, consequently, international trade—are conducted.

In Brazil, the Brazilian Development Bank (BNDES – Banco Nacional de Desenvolvimento Econômico e Social) has already been developing Blockchain-based solutions aimed at recording public expenditures in a traceable and transparent manner, thereby enabling greater social oversight and facilitating auditing mechanisms.

The Central Bank of Brazil has also developed its own Blockchain-based project, known as PIER (Platform for the Integration of Information among Regulatory Entities), with the objective of facilitating data exchange among government agencies, including the Securities and Exchange Commission of Brazil (CVM), the National Superintendence for Complementary Pensions (Previc), and the Superintendence of Private Insurance (Susep).

The Central Bank's Blockchain-based platform has been under development since August 2017 by the institution's Information Technology Department and has been integrated with other data service platforms already in operation.

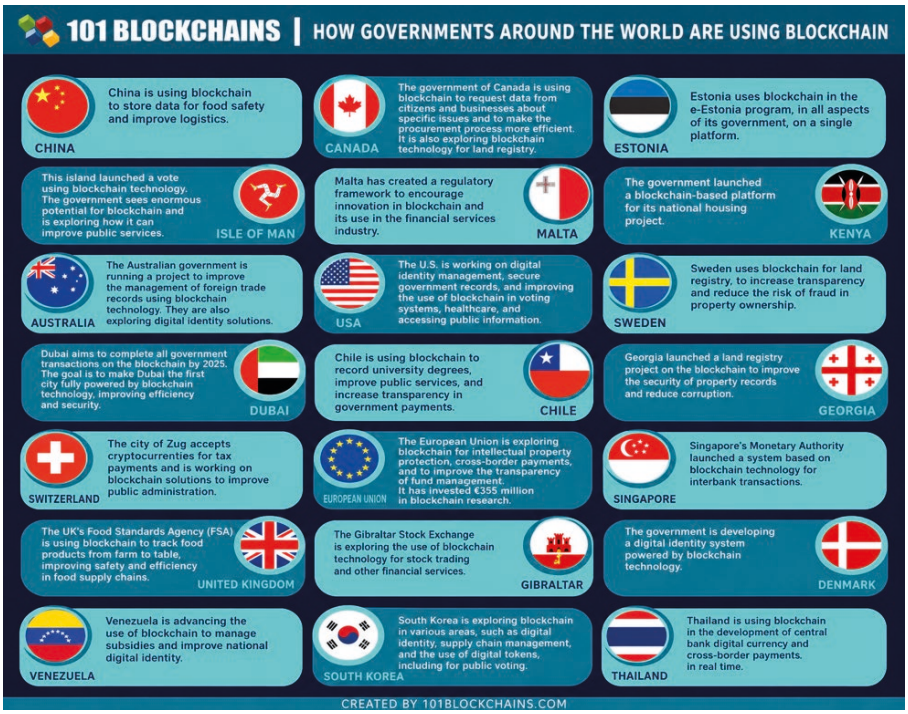
The following figure presents examples of countries that have adopted Blockchain technology in different forms and at varying levels of implementation.

Finally, El Salvador adopted Bitcoin as legal tender in 2021 with the aim of attracting foreign investment, fostering financial innovation, and reducing the costs of remittances sent by Salvadorans living abroad. Furthermore, president Nayib Bukele's administration sought to promote financial inclusion in a country where a significant share of the population lacked access to traditional banking services.

However, Bitcoin adoption among the population remained limited due to its high price volatility, public distrust, and implementation challenges associated with the government's Chivo Wallet. By 2024, fewer than 10% of Salvadorans were still using Bitcoin on a regular basis. Facing pressure from the International Monetary Fund (IMF) and as part of the conditions for obtaining international financial support, the government amended the law in 2025, revoking Bitcoin's status as legal tender and making its use entirely voluntary (BBC News Brasil, 2025).

Figure 4 presents examples of how governments around the world are adopting and implementing Blockchain technology.

Figure 4 – Government Applications of Blockchain Around the World



Source: Based on the Portuguese version of 101blockchains.com (2018), translated into English by the authors.

3.2. Cryptocurrencies

According to Souza (2017, 60), technological advances in the field of information technology have enabled individuals to conduct virtual transactions, giving rise to a new form of currency. This development was made possible through Blockchain technology.

A cryptocurrency is characterized as an asset that operates without bureaucracy or intermediaries, preserves user anonymity, and allows transactions to be conducted at little or no direct cost. Its most distinctive feature, however, is the absence of a regulated monetary system and its independence from any central financial authority, a characteristic commonly referred to as decentralization.

Because cryptocurrencies exist exclusively in digital form, they are created through highly rigid and non-discretionary mechanisms based on open-source code, making counterfeiting virtually impossible. Exchange rates and purchase and sale transactions are determined through online markets, allowing value transfers to occur without the fees typically charged by traditional banking institutions for similar services (Ulrich 2014).

The most well-known cryptocurrency is Bitcoin, which emerged in 2009 and is widely regarded as the world's first decentralized currency. In addition to Bitcoin, other prominent cryptocurrencies include Litecoin, Ethereum, Ripple, Monero, and many others. All these virtual currencies operate through Blockchain technology, without the mediation of any financial institution or regulatory authority.

Souza (2017, 60) examined the possibility of establishing legal frameworks to regulate the circulation of cryptocurrencies in cyberspace, as well as alternative mechanisms capable of governing the use of virtual currencies as instruments for facilitating legal and commercial transactions.

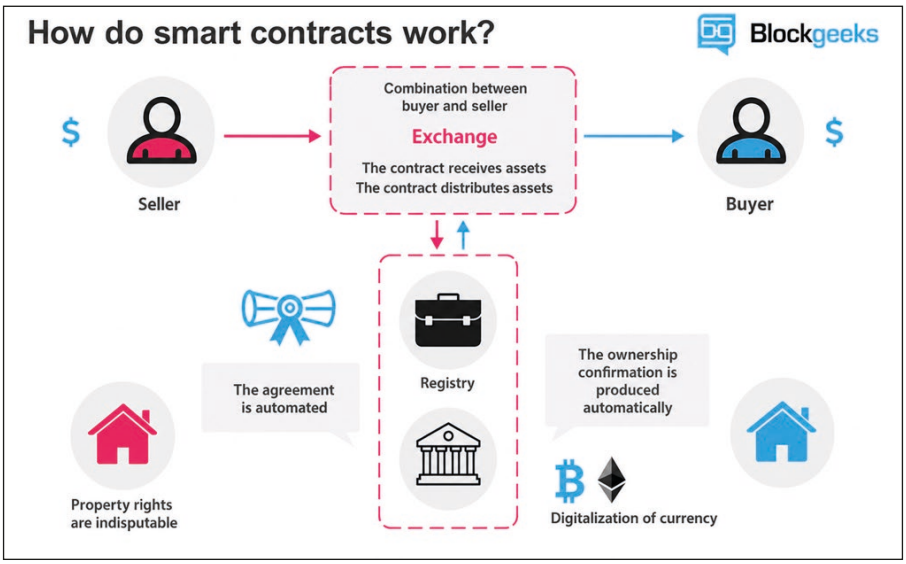
Marinho and Ribeiro (2017, 142), in turn, sought to demonstrate how the concept of jurisdiction may be redefined within virtual environments, given the ability of these technologies to generate levels of trust and speed in dispute resolution far exceeding those previously available. This transformation creates a growing separation between the exercise of jurisdiction and territorial boundaries, potentially affecting the role of the State as the exclusive authority responsible for jurisdictional functions and the traditional notion of territoriality.

According to Vanzo (2017, 33), cryptocurrencies cannot yet be fully regarded as money in the strict sense of economic theory. Nevertheless, as their use continues to expand—particularly because of their global reach—they may, in the near future, increasingly fulfill traditional monetary functions, such as serving as a store of value and a unit of account.

3.3. Smart Contracts

Smart contracts are self-executing digital agreements in which the terms and conditions are encoded into computer code and automatically enforced when predefined conditions are met. By eliminating the need for intermediaries, they enhance efficiency, transparency, and security in a wide range of transactions. Figure 5 illustrates the operation of a smart contract.

Figure 5 – Operation of a Smart Contract



Source: Based on the Portuguese version of Blockgeeks (2017), translated into English by the authors.

In this way, a smart contract is drafted in a programming language in which clauses, rights, duties, obligations, and penalties are established for both parties involved. These contracts operate autonomously, independently from the direct intervention of the State's judicial authority, making them less bureaucratic and, as a rule, more cost-effective.

According to Frazão (2019), regardless of the manner in which it is constituted, a smart contract offers a number of advantages, particularly when it comes to overcoming the problem of trust. In this context, trust is transferred to the Blockchain itself, which guarantees the contract's enforceability and execution.

Schechtman (2019, 12) emphasizes that the main characteristic that makes smart contracts especially relevant is the absence of a trusted intermediary, traditionally responsible for ensuring compliance with the obligations agreed upon by the parties. In many cases, this role is performed by the State through the judiciary, mediation and arbitration mechanisms, or the enforcement of contractual guarantees. In smart contracts, however, the self-execution of pre-programmed terms eliminates the need for such intermediaries, providing greater speed in transactions while reducing both bureaucracy and the financial costs involved.

4. Final Remarks

The advent of cryptocurrencies—widely popularized through the general public's interest in understanding how Bitcoins are bought, sold, and traded—has ultimately overshadowed the system underlying the currency itself. However, it is precisely this system that has the potential to profoundly impact the transactional, economic, and legal relationships arising from its increasingly widespread use.

The main arguments supporting the adoption and utilization of Blockchain Technology point to cost reduction, data security and immutability, and the decentralized nature of the system as key factors underlying its effectiveness.

In international trade, every stage of a transaction requires time, incurs costs, and involves significant levels of bureaucracy. Equally important are the security concerns associated with these procedures.

The fundamental proposition of Blockchain is to provide a technological tool capable of simplifying such processes, reducing the time required for the initiation, execution, and completion of commercial transactions. For this reason, this study sought to deepen the analysis of smart contracts—self-executing digital agreements—which enhance security at every stage of a transaction and are likely to play an increasingly important role in legal and commercial dealings in the near future.

Smart contracts have the potential to significantly transform the way negotiations are conducted by providing greater security to the parties involved and ensuring traceability throughout the entire process, from origin to final consumer.

From a bureaucratic perspective, Blockchain, through electronic contracts, has the potential to streamline procedures such as the issuance and release of letters of credit, customs clearance processes, phytosanitary certifications and validations, as well as insurance contracting and coverage.

Research on Blockchain and its implications for international trade remains relatively recent and encompasses multiple fields of knowledge, including information technology, economics, international trade, and law. For this reason, although this study has sought to present some of the effects of this technology, its scope remains broad and continues to evolve.

Accordingly, numerous avenues for future research remain to be explored. These investigations will undoubtedly contribute to increasing the speed and efficiency of transactions, progressively transforming the way business activities are conducted on a global scale.

Thus, it can be argued that society is undergoing a process of transformation in which the adoption of these technologies is likely to profoundly alter the functioning of the economy and, potentially, human relationships in a broader sense.

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