Securities Tokenization: The Third Wave of Financial Market Evolution

-World Bank Bond-i case study-

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Abstract:

This research aims to study securities tokenization technology as the third wave of financial markets development, with a review of the experience of the World Bank in the field of issuing i-bonds, using the descriptive analytical approach. It was concluded that securities tokenization is an innovative technology in the financial markets based on blockchain technology -whether the tokenization is off-chain or native in it- has many advantages, such as increasing market liquidity, expanding the investor base, automating the life cycle of securities, settlement and delivery of securities, publishing their prices in real time and reducing cost. The World Bank's experience is considered the first and pioneering experience in this field, through the issuance of the first tokenized bond in 2018, which achieved many advantages such as learning, efficiency, transparency and auditing.

Keywords: Financial Markets ; Tokenization ; Securities Tokenization ; Bond-i; World Bank.

Jel Classification Codes: G10,O33.

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1. Introduction :

The emergence of blockchain technology that relies on advanced technologies, such as storing and validating financial transactions via the Internet, by distributing databases to dealers in an encrypted form, and a degree of encryption that is impossible to break in light of the technologies available today, has led many financial industries to seek to adopt this technology, and the use of smart contracts and encrypted currencies to facilitate their work, and increase the efficiency of financing operations. The process of assets tokenisation is one of the most prominent uses of blockchain technologies and distributed ledgers, whether these assets are financial assets such as stocks and bonds, commodities such as gold or non-financial assets such as real estate.

Securities tokenisation technology is a new revolution of blockchain, as the latter helped to create a new model for financing and increasing capital by simplifying the life cycle of securities, as the issuance, trading and payment of securities are done electronically (smart contracts) and in a coded manner, through platforms exist at the level of the blockchain network, which has reduced the challenges facing the financial markets, especially in the field of costs, verification of transactions, increased liquidity, ease of settlement of transactions and implementation of clearing. The World Bank is the first institution in the world to issue the first tokenisedbond (bond-i) through the blockchain network in 2018, which led to the achievement of many advantages such as learning, efficiency, transparency, auditing and reporting.

Based on what is mentioned above, the problem of this research has been formulated in the following main question:

What is meant by the securities tokenization process? What are its effects on financial markets؟

The main question has the following sub-questions:

- What is meant by tokenization technology in general? What are its stages and types؟
- What are the basics of the securities tokenization process? What is the difference between them and security Token؟
- What are the effects of securities tokenization on financial markets ؟
- How were World Bank bonds tokenized? What are the benefits of this process؟

To answer the main question and sub-questions, the following hypothesis was adopted:

There is a relationship between the technology of securities tokenization and facilitating procedures for issuance, trading, settlement and reducing costs.

- **Research Importance**: This research is of great importance, as it is one of the new topics that have not yet received its share of research. Technology has affected all sectors, especially the financial sector. The technological development, especially the blockchain technology, has revolutionized the financial industry.

This technology has contributed to the transformation of many transactions and financial instruments into digital or symbolic form (tokenization), which has led to a radical change in the field of financial markets.

- **Research Objectives**: This research aims to achieve the following points:

  -Knowing the asset tokenization technology, its stages and types ;

  -Knowing the basic concepts related to securities tokenization technology؛

  -Realizing the effects of securities tokenization on financial markets;

  -Learning how to issue World Bankbond-i, and the benefits of this process.

- **Research methodology**: To study this topic, and to answer the main question and sub-questions, the descriptive analytical approach was adopted, the latter of which relies on data collection and analysis in some detail in order to reach results. For this purpose, many references of close relevance have been adopted.

- **Literature of previous studies**: There are a limited number of studies that dealt with the issue of assets tokenization in financial markets, because it is a new topic. Among the previous studies, we mention:

1-**Iota KaousarNassr** study entitled: **Understanding the tokenization of assets in financial markets** (2021): This study dealt with the issue of tokenizing assets in financial markets, by explaining the concept of this process and its potential benefits and risks. In addition to highlighting some regulatory approaches related to tokenizing assets in order to enhance financial stability in general, and in some countries in particular.(Nassr, 2021)

2-**Laurence Van der Loo & al** study entitled: **Tokenised Securities: A Roadmap for Market Participants and Regulators** (November 2019): This study deals with the concept of Tokenised securities, showing the advantages of this type of securities, in addition to comparing them with traditional securities in several aspects (issuance - structuring - primary market - secondary market - regulation). In addition to trying to identify aspects of the appropriate environment for Tokenised securities.(Loo & all, 2019)

3-**R3**study entitled: **Digital Assets: Transforming Capital Markets** (May 2019): This study began by showing the beginning of the financial technology revolution (from cryptocurrencies (Bitcoin) to tokenized assets), then clarifying the types of tokens (asset-based and native to the network). The importance of the R3 Foundation and its platform Corda in facilitating tokenization transactions in the blockchain system was also demonstrated.(R3, May 2019)

What distinguishes this research from previous studies:

- Trying to explain the effects of tokenized securities on the financial markets, while clarifying the theoretical aspects related to tokenization in general, and the tokenization of securities in particular؛
- Exposure to the experience of the World Bank in the field of issuing bond-i.

2. Asset Tokenization: A Theoretical Background:

2.1. Definition of asset tokenization: Asset tokenization is defined as:

- According to **IotaKaousarNassr**, it is: "The process of digitally representing physical assets on distributed ledgers, or issuing traditional asset classes in token form."(Nassr, 2021, p. 5)
- **The Financial Stability Board (FSB)** defines it as: "Representation of traditional assets -for example financial instruments - and a basket of collateral or real assets- on a distributed ledger, where ownership of securities can be recorded on a blockchain that uses smart contracts to define security terms and tokenized assets. Smart contracts use computer protocols to implement, verify, and constrain the contract. In doing so, they can automate the decision-making process, by allowing self-executing computer code to take action at specific times, or based on indicating the occurrence (or non-occurrence) of an action or event. Where tokenization is used as part of the process of raising capital, and they can decentralize this activity away from financial intermediaries."(FSB, 2019)
- **The pwsFoundation**defines it as: "Tokenisation is a process of transforming sensitive information, with a unique symbol that preserves the critical data without compromising its security, into another simple form. It is a digital representation of an asset or currency that can be traded or exchanged with the use of a blockchain."(pwc, 2021)
- "Converting financial, real estate and other assets that are used in the issuance of structured financial instruments, such as sukuk, project bonds and structured sustainable financing instruments, into digital assets using encryption and tokenization techniques on distributed ledger networks."(يوسف، 2021)

So, asset tokenization is a process whereby assets are replaced for digital tokens, which are formed, used and traded via smart contracts in distributed ledgers at the blockchain network.

2.2. Tokenization features:

The features or characteristics of the tokenization process can be summarized in the following points:(Mogull & Adrian , no date) (pwc, 2021)

- Assettokenization is the process of converting an underlying asset into another unit of digital or physical asset called tokens;

- Tokenization helps transform assets into a digital unit that can be managed without an intermediary through blockchain technology;

- A token is not completely worthless - it is significant in its application environment- but its value is limited to the environment, or even a subset of that environment;

- Like derivatives or mutual funds, tokenized assets derive their value from another asset that generates cash flows or economic value when sold or transferred;

- Asset tokenization helps in dividing complex assets into a simple form or unit that can be easily exchanged for cash or assets. They are not able to obtain it, while enabling issuers to raise more capitalto finance the project.

2.3. Tokenization Process Model:

The tokenization process (fig n°1) is carried out according to the following model:(Mogull & Adrian , no date, p. 9)

1- The tokenization application collects or creates a piece of sensitive data;

2- The data, after being collected, is sent immediately to the tokenization server, where it is not stored locally;

3- The tokenization server generates the random or semi-randomtoken. The sensitive value and its token are storedin a highly secure restricted database, usually encrypted;

4- The tokenization server returns the token to the application;

5- The application stores the token, instead of the original value, and the token is used for most transactions with the application;

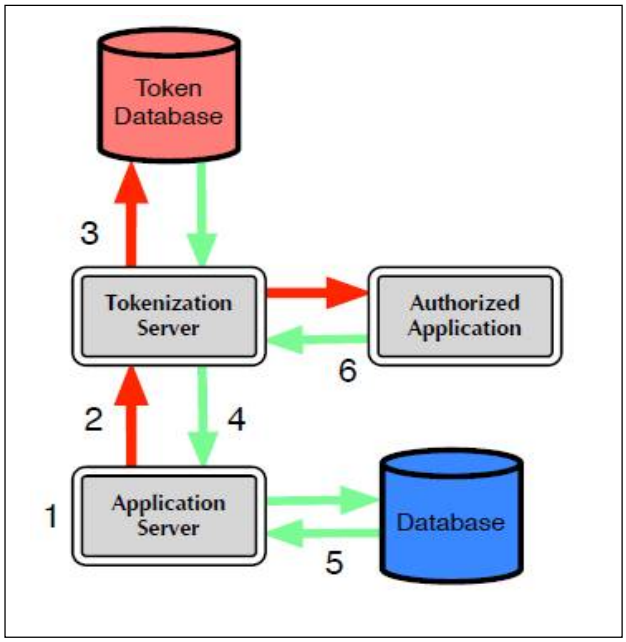
6- If a sensitive value is needed, it is requested by the application or an licensed user, as the value is never stored in any local databases, and in most cases access is severely restricted, which greatly limits potential exposure;

But for this to work, you must make sure of the following:(Mogull & Adrian , no date, pp. 9-10)

- There is no way to reproduce the original data without the tokenisation server, which makes tokenization different from cryptography. The latter in which through the use of a key and encryption algorithm you can restore the value anywhere;
- All communications are encrypted;
- The application does not store the sensitive value, it only stores the token;
- The application never touches the original value. There are architectures and deployment options to divide responsibilities; for example, having a transactional system that is not accessible to the user with access to sensitive data separated from the customer-facing side. You could have one system that collects data and sends it to the tokenization server, another that handles daily customer interactions, and a third system for transactions that require real value;
- Tokenization server and database are very secure, modern implementations are more complex and efficient than a locked database that has both sets of values stored in a table.

The following diagram shows the Tokenizationprocess model.

Fig N° 1:Tokenization Process Model



Source: Rich Mogull& Adrian Lane, Understanding and Selecting a Tokenization Solution, Securosis, L.L.C., no date, p.9

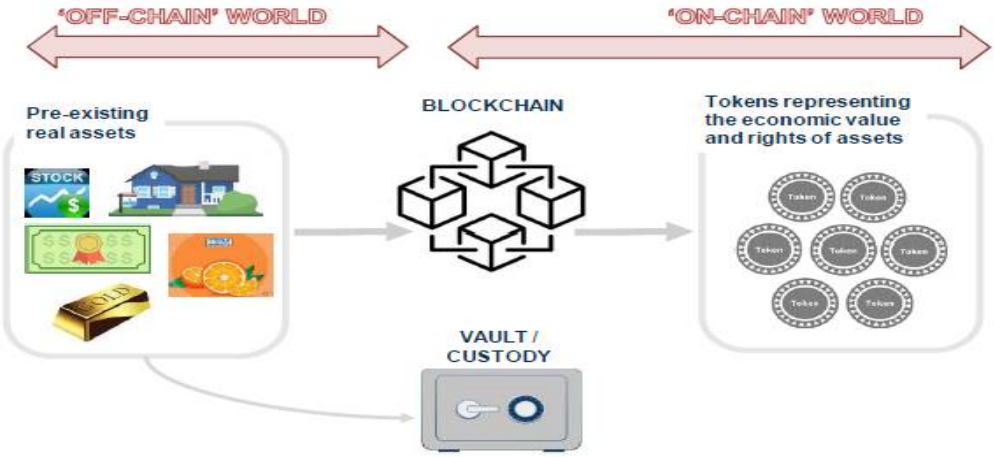
2.4.Types of tokenization:

Two types of tokenization can be distinguished: (OCDE, 2020)

2.4.1. Tokenisation of real assets that exist off-the-chain: This type of tokenization involves tokenizing real assets that already exist in the real world into a distributed ledger, by associating the economic value and rights derived from those assets into digital tokens that are generated on the blockchain.

Tokens issued under asset tokenization exist on the chain, hold the rights to the assets they represent, and act as a store of value, while real assets continue to be out of the chain. Assets must usually be placed in custody to ensure that their tokens are consistently backed by these assets. The following diagram illustrates this.

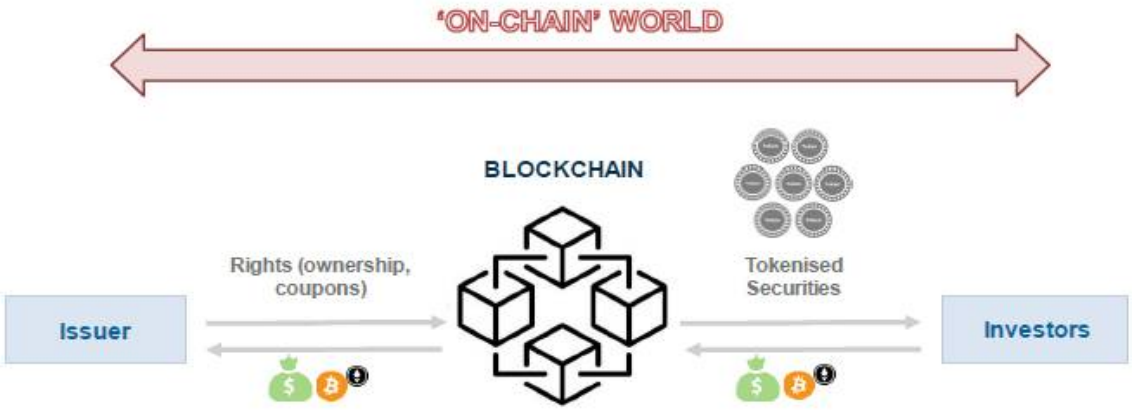
Fig N° 2.Tokenisation of real assets that exist off-the-chain



Source: OECD, The Tokenisation of Assets and Potential Implications for Financial Markets, 2020, p.12.

2.4.2. Tokenisation of assets native to the blockchain: The "native" tokens are generated directly on the chain and live exclusively on the distributed ledger. Bitcoin and other cryptocurrencies and payment tokens are examples of "native" tokens.Native tokens derive their value in and of themselves, and are determined by their presence on the blockchain. The following figure illustrates this.

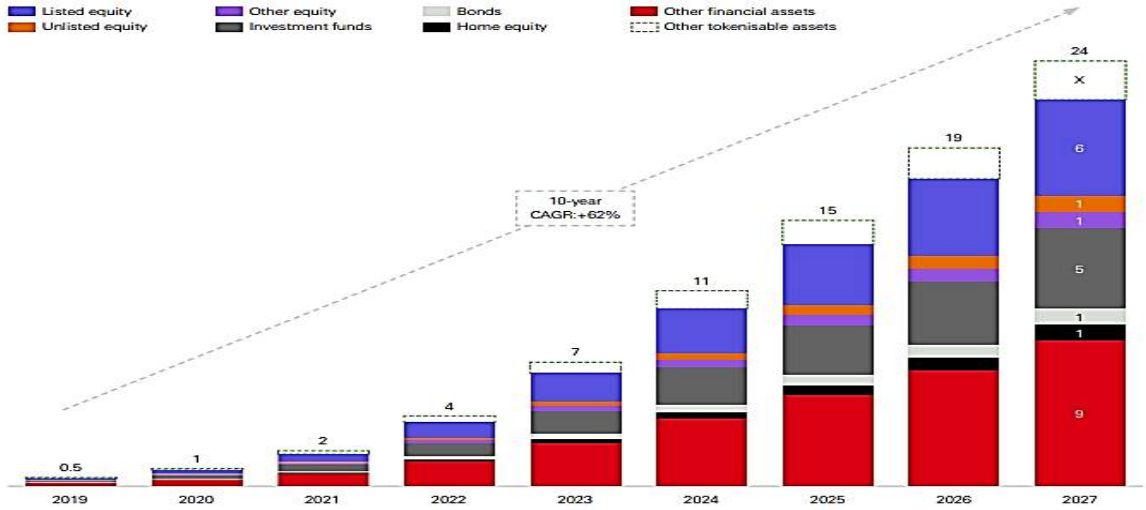
Fig N° 3.Tokenisation of assets native to the blockchain



Source: OECD, The Tokenisation of Assets and Potential Implications for Financial Markets, 2020, p.12.

It should be noted that the size of the tokenized assets market has increased continuously, and is expected to reach $24 trillion in 2027. The chart shows this.

Fig N° 4.The evolution of the tokenized assets market sizeduring the period 2019-2027



Source: Rajeev Tummala& al, The 10x potential of tokenisation "Democratising investment opportunities", HSBC, no date, p.5.

3. Tokenisation and its impact on financial markets

3.1. Stages of digital transformation in financial markets:

Before the definition of tokenization securities, the most important stations that the financial markets have gone through until they have reached the stage of digital development are exposed. It should be noted that the financial markets have gone through three basic phases (waves):(مؤسسة دبي للمستقبل، 2020)

- **The first wave**: **access to assets**: by converting assets into negotiable securities. This stage witnessed a rapid growth of exchanges and increased liquidity, which paved the way for the growth of European financial centers, such as Amsterdam and London.

- **The second wave**: **digitization of financial markets**: dematerializing securities and introducing them at the level of a computer network (dematerialization of securities), which led to the development of global liquidity and diversification of the investment portfolio.

- **The third wave**: **digitally tokenization ofsecurities**: a new model based on the representation of traditional securities with tokens on the blockchain.

The following figure shows the stages of digital development in financial markets.

Fig N° 5.The stages of digital development in financial markets

Source: prepared by the researcher.

3.2. What is meant by tokenized securities and security tokens:

Tokenized securities are defined as:

- "Traditional securities such as stocks and bonds that are dematerialized, through a system based on distributed ledger technology, or transferred to a similar system."(مؤسسة دبي للمستقبل، 2020، صفحة 12)

So, it can be said about Tokenized(encrypted) securities that they are digital securities, which have no physical presence except on the ledger distributed in the blockchain network, and according to that, the transition from the phenomenon of the materiality of securities to the immateriality of securities took place.

- Security tokenization are defined by ***Luc Falempin and others*** as follows: "Security tokenization is the process of materializing the ownership in a security through the issuance of a "token" registered on a distributed ledger technology (DLT) infrastructure. Therefore, a tokenized security can be equity, a bond, or an investment fund. It could also represent a securitized fraction of a real asset (e.g. a piece of art)."(Falempin & al, 2019)

In 2018 is the inaugural year for Security Token Offerings (STOs) and many believe that by 2030 tokenized securities will be the primary method of issuance. (Falempin & al, 2019)

It should be noted that there are differences between tokenized securities and security tokens, which can be clarified in the following table.

Table N°1:Difference between tokenized securities and security tokens

	Tokenised Security	Security Token
Definition	The tokenised security corresponds to a security that exists outside of a blockchain, and can be described as being 'blockchain-embedded'.	A security token represents a security that does not exist outside of a blockchain, and can be described as being 'blockchain-native'.
Nature	-Tokenised securities represent traditional securities on a blockchain in order to take advantage of potential efficiencies arising from the use of blockchain for property registration and transfers - Other features can also be created on top of tokenized securities, but the underlying assets and their terms must always be observed. -The possibility of automating payments, to the extent that integrations can be built between the cryptographic blockchain and the payment blockchain networks that represent a form of digital cash.	- Security tokens largely imitate the features of traditional securities, although there is potential for disruption when structured products are put on top. The potential efficiencies are enormous. - Not only can ownership and transfers be automatically recorded on the blockchain, but payments (such as bond coupons) can also be automated.
Similar to	Depositoryreceipts	Bearerassets

Source :ASIFMA, Tokenised Securities A Roadmap for Market Participants and Regulators, November 2019, p.10.

3.3.The implications of tokenization on financial markets

Blockchain technology, through tokenized securities, simplifies the life cycle of traditional securities, as it reduces the settlement and clearing period, expands the investor base, enhances liquidity, ensures the validity of operations, conducts operations, and trades.

The effects of the tokenization process on financial markets can be explained on several levels, which can be illustrated in the following figure.

Fig N° 6: Levels of tokenization impact on financial markets

المصدر:نوران يوسف، استراتيجيات رقمنة أسواق الأوراق المالية الحكومية في الدول العربية، صندوق النقد العربي، ديسمبر 2021، ص.19.

The repercussions of the tokenization process on financial markets can be summarized as follows(يوسف، 2021):

a. Recording and saving data: Blockchain technology can record and save data in a huge amount and share it securely, so this technology has helped the financial markets in the field of recording, preserving and managing data of tools, assets, investors, settlement processes, preservation and trading, and sharing them simultaneously

with a great deal of transparency, as the blockchain contributes to recording and saving asset data to be used in offering various securities and structured securities.

b. Expanding the investor base: Tokenized securities contribute to expanding the investor base, especially individuals and small and medium enterprises, because the tokenization technology allows the division of securities with huge amounts into small denominations with reasonable amounts, which allows them to be purchased by investors, especially small ones.

c. Real-time clearing and settlement of securities: Blockchain technology automates the life cycle services of financial instruments in near real time, with the participation of all participants in the network, which leads to the following:

- reduces duplication of operations and procedures on the one hand and verification of balances and ownership of securities on the other hand;

- Reducing the time and procedures for verifyingthe settlement of trading and post-trade transactions;

- Executing transactions and their associated rights and obligations through smart contracts, which automates the return payments on tokenized securities on time;

- Verifying and approving settlement instructions to different degrees;

- Speed and efficiency of clearing and settlement operations;

- Achieve higher levels of implementation of money laundering and terrorist financing compliance requirements and simplify Know Your Customer (KYC) procedures and And Know Your Customer's Customer (KYCC) procedures.

d-Trading and Post-Trading Operations:Securities tokenization provides secure and real-time channels for real-time approval and settlement of trades, allowing for real-time settlement against delivery, with the publication of financial instrument prices and enhancing market liquidity.

e. Liquidity: The tokenization process contributes to providing liquidity in the primary market and the secondary market through:

- Dividing tokenized financial instruments and facilitating access to financial markets, and distributing these instruments to the largest possible segment of investors;

- Decreased settlement period, which enhances the balances of main dealers and market makers, thus providing more liquidity.

f- Reducing time and cost : This is done through:

- Reducing the time and complexities of clearing and settlement cycles for financial instruments, which reduces costs;

- Reducing the cost of services related to the life cycle of securities from issuance to maturity.

g. Control, supervision and compliance with regulatory rules: where:

- Blockchain technology provides real-time reports on various transactions in a transparent manner, which enhances the ability of regulators to follow up on securities operations;

- The possibility of following up the performance of dealers in the market and their compliance with regulatory rules.

The euroclear report summarizes the impacts of adopting tokenized securities via blockchain technology in the following chart.

Fig N° 7: Impact of Tokenization on Financial Markets

Source : Oliver Wyman, Blockchain in capital markets : the prize and the journey, euroclear, February 2016, p.12.

In general, the new token economy offers the possibility of a more efficient financial world through: (Laurent & al, no date)

- Greater liquidity: By tokenizing securities, these tokens can be traded on the secondary market, which leads to access to a broader base of traders and increased liquidity, which benefits investors, because the tokens benefit from a liquidity premium, thus getting more value than the underlying asset.

- Faster and Cheaper Transactions: A token transaction is completed using smart contracts (software algorithms embedded in the blockchain with an operating procedure based on predefined parameters), certain parts of the exchange process are automated, which reduces the administrative burden involved in buying and selling, with the need to fewer intermediaries, which not only leads to faster deal execution, but also lower transaction fees.

-More transparency: A security token is able to have the token holder's rights and legal responsibilities built directly into the token, along with an immutable ownership record. These characteristics are in addition to

transparency, allowing to know who you are dealing with, what your rights are and theirs, and who previously owned this number.

- More accessible: Most importantly, the token can open up investing in assets to a much wider audience thanks to minimal investment amounts and periods. Tokens are highly divisible, which means that investors can buy tokens that represent incredibly small percentages of the underlying asset. If each order were cheaper and easier to process, it would open the way to a significant reduction in the minimum investment amounts. Moreover, the higher liquidity of the security tokens could also reduce the minimum investment periods, since the investor could exchange their tokens in the secondary markets 24 hours on 24 hours.

4. A case study of the World Bank (bond-i):

4.1. Operation Overview:

An overview of bond-i issuance process undertaken by the World Bank can be given as follows: (WB, 2018)

-The World Bank launched what was known as the bond-i, which is the first bond in the world to be created, allocated, transferred and managed during its life cycle using distributed ledger technology. The two-year bond raised A$110 million, marking the first time investors have backed the World Bank's development activities in an entirely blockchain-powered transaction;

-Bank authorized Commonwealth Bank of Australia (CBA) as bond regulator on August 10, and following the announcement of a market consultation period, major investors indicated strong support for the market;

-The investors in these bonds are: CBA- First state super corporation- NSW Treasury Corporation- Northern Trust- SAFA- QBE- Treasury of Victoria;

-The Blockchain Bond-i platform was built and developed by the CBA Blockchain Center of Excellence located in the Sydney Innovation Lab. This project builds on the leadership and expertise of the CBA's dedicated Blockchain Team, which has played a pioneering role in applying blockchain technology to the financial markets. Founding investors contributed to the deal with their comments on the platform's structure and functionality.

-In this regard, ArunmaOtei(Treasurer of the World Bank)said..... "I am delighted that this pioneer bond transaction using the distributed ledger technology, bond-i, was extremely well received by investors. We are particularly impressed with the breath of interest from official institutions, fund managers, and banks. We were no doubt successful in moving from concept to reality because these high-quality investors understood the value of leveraging technology for innovation in capital markets";

James Wall, CEO of CBA and IB&M International, said, “Since announcing the mandate, the interest we’ve received for bond-i has been overwhelming. It is clear the market is ready and open to the uptake of

emerging technologies and sees the potential evolution of the capital markets. It has been a pleasure to work on such a ground-breaking transaction with a forward-thinking organization like the World Bank".

The following table gives us a summary of the bonds-i issued by the World Bank.

Table N°2: summary of the bond-i deal

Issuer:	World Bank (International Bank for Reconstruction and Development, IBRD)
Issuer rating:	Aaa/AAA
Amount:	AUD 110 million
Settlement date:	August 28, 2018
Maturity date:	August 28, 2020
Coupon:	2.20% p.a. payable semi-annually in arrear
Coupon payments:	28th February and 28th August in each year
Re-offerprice:	99.901%
Re-offeryield:	2.251% semi-annual
Denomination :	AUD 1,000. The minimum consideration payable when issued in Australia: AUD 500,000
ISIN :	AU0000020612
Lead manager :	Commonwealth Bank of Australia

Source :WB, World Bank Prices First Global Blockchain Bond, Raising A$110 Million, Agust 23, 2018. From the site: https://www.worldbank.org/en/news/press-release/2018/08/23/world-bank-prices-first-global-blockchain-bond-raising-a110-million

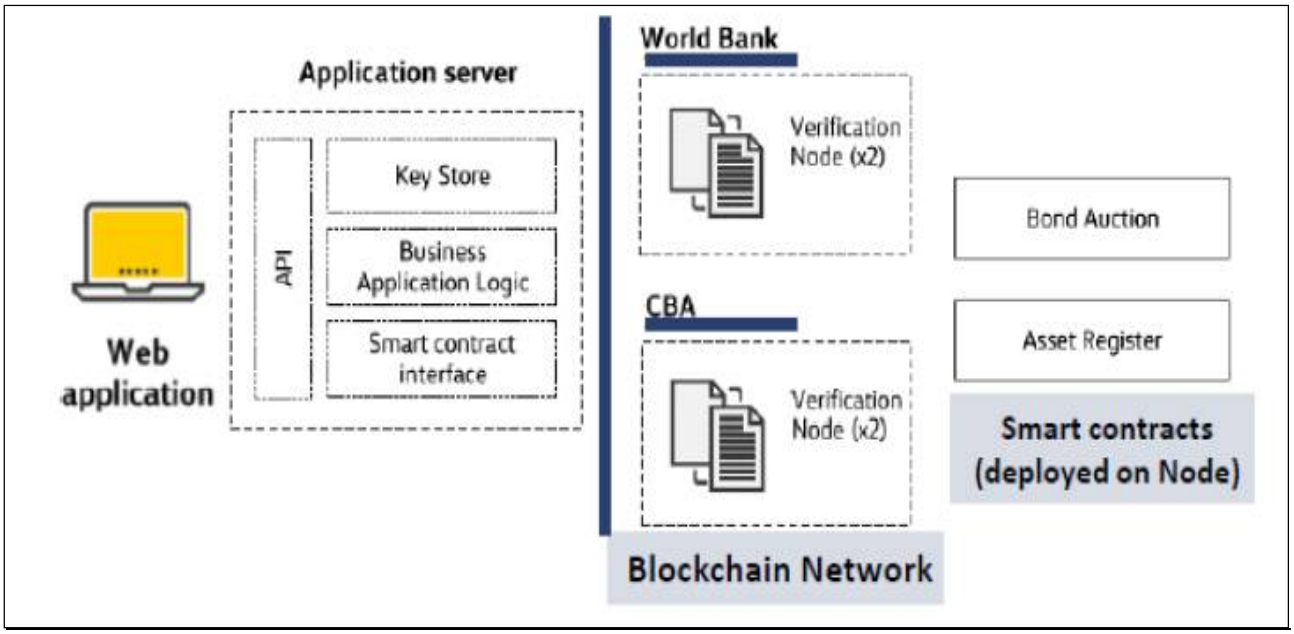
4.2. Stages of the process:

The process of issuing bond-i took place according to the following stages:(World Bank's Global Blockchain Bond : Bond-i transaction Overview, no date)

- The World Bank launchedbond-i on a private and licensed blockchain platform;
- Pre-authorized investors use their authentication key, and enter bids on the platform through the web interface;
- The World Bank monitors the block building process in real time;
- Finishing the pricing process;
- Investors update their bids supported by contacting the World Bank via the Internet;
- Investors see their offers in real time;
- The record is based on a ledger maintained by the CBA in Sydney;
- Cash settlement is off-chain.

The following figure shows the stages of the process.

Fig N° 8: Stages of bond-i process



Source: OECD, The Tokenisation of Assets and Potential Implications for Financial Markets, 2020, p.44

4.3. Benefits of the operation:

The process of issuing bond-i has achieved many advantages, which can be summarized in the following points:(World Bank's Global Blockchain Bond : Bond-i transaction Overview, no date)

-**Learning**: The World Bank's learning opportunity not only to develop the capital market, but also to harness the potential of disruptive technologies in many areas, such as land management, supply chain management, education, cross-border payments, etc.

- **Efficiency**: a single source of information for verification and continuous through the ledger ;

-**Transparency**: Making information available in real time to investors and issuers;

-**Mechanism**: applying the rules of the smart contract, then automating and simplifying the process;

-**Audit and Reporting**: Automated reporting improves reporting for investors, issuers and regulators.

5. CONCLUSION:

Securities tokenization is considered a revolution in the field of financial markets, and through studying this topic and reviewing the experience of the World Bank in the field of bond-i issuance, the following was reached:

- Tokenization is an innovative process in the financial markets, based on the conversion of securities into distinct digital tokens, through special applications that operate exclusively on the distributed ledger in the Blockchain network;
- There are two basic types of tokenization, some that are off-chain and closely related to real assets in the real world, and some that are native and exclusive in the blockchain. The tokenized asset market has developed significantly over the recent years and is expected to continue for the next few years.

- The financial markets went through three basic stages until they reached the stage of digital transformation (securities tokenization), the latter of which had many effects on the financial markets, especially in the areas of:

• recording and saving data in a huge and secure amount;

• Expanding the investor base, especially individuals and small and medium enterprises;

• Automating the life cycle of securities in a timely and secure manner;

• Real-time settlement of securities, with the publication of securities prices and the enhancement of market liquidity;

• Reducing time and costs;

• Increase oversight and compliance with regulatory rules.

- The World Bank experience is the first global experience in the field of issuing bond-i using a distributed ledger, and managing the process entirely on the blockchain network, in 2018. The process achieved remarkable success, as 110 million Australian dollars were raised
- The experience of bond-i has brought many advantages to the World Bank, such as increasing the opportunity for learning, raising levels of efficiency, increasing transparency, and improving reporting to investors and issuers.

Research proposals: From what was mentioned in this research, the following can be suggested:

- Encouraging financial markets to create digital platforms that help adopt tokenization technology, especially since it has many advantages;
- Despite the advantages of the tokenization process in the financial markets, it carries with it many risks that may threaten financial stability, so it is necessary to prepare regulatory approaches related to that;
- The adoption of this technology requires the availability of a strong technological infrastructure, so the latter must be provided before adopting the tokenization process, especially in developing countries.

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