taxnotes® international

Volume 112, Number 2 ■ October 9, 2023

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Reprinted from *Tax Notes International*, October 9, 2023, p. 245

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In this article, Lanotte explains why technological advances like blockchain have the potential to revolutionize tax systems worldwide.

I. Introduction: Blockchain Tech and Tax

After more than two years of the pandemic, two distinct but related changes took place: the increased importance of digital transformation, and the physical distancing (and the risk of losing social connection that comes with it) that has become the norm. The shift to a "more digital"[1] world is amplified by the high degree of dematerialization that characterizes so-called digital enterprises, whose business model is exclusively or primarily digital. New technologies like blockchain[2] can revolutionize transaction recording and taxation, as well as automate many of the processes that make up tax systems today.

However, for taxation of the digital economy to work, the introduction of a digital approach to taxation is necessary. This calls for more unified actions to address the problem of fragmented and uncoordinated taxation systems across jurisdictions and the alleged ability of companies to reduce their tax base and shift profits to countries with lower taxation. The adoption of blockchain technology presents many legal and regulatory challenges, like protecting consumers and combating criminal activities. However, a more accessible and innovative financial and tax system[3] is needed in the global environment that can improve transaction taxation, automate most tax processes, and simplify burdensome administrative requirements.

This applies in particular to VAT,[4] real estate sales tax, and annual tax returns. The benefits of blockchain implementation can be enormous in the following areas: transfer pricing due diligence analysis, country-by-country reporting, and information exchange (DAC system), particularly in light of the upcoming DAC8 and the

[1] Antonio Lanotte, "Toward a Digital Supply Chain and a Digital Taxation," *Tax Notes Int'l*, Jan. 9, 2023, p. 239.

[2] Lanotte and Trang Fernandez-Leenknecht, "Blockchain and Smart Contracts in Tax," *Tax Notes Int'l*, Oct. 18, 2021, p. 325.

[3] Alfredo Collosa, "Blockchain in Tax Administrations," *CIAT* (June 14, 2021). Brazil's federal tax administration has implemented a blockchain-based system called bCPF to share taxpayer/individual registry data among tax and regulatory institutions of the three levels of government (federal, state, and municipal). The next step is the implementation of the blockchain-based legal entity registry, the bCNPJ, with the same goals. It uses an authorized blockchain based on verifiable open-source software, in which only authorized institutions can participate.

[4] Lanotte, "The Potential of Blockchain for VAT Recovery and Compliance," *ITR* (Apr. 22, 2019). There are proposals for other tax applications of blockchain, like development of specific cryptocurrencies to reduce VAT fraud in transactions within the European Union. Blockchain could solve many of the system's weaknesses by creating a digital invoice register, which would allow tax authorities across Europe to view and verify taxes paid when a product changes hands.

implementation of Markets in Crypto-Assets Regulation (MiCA).[5]

The blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a corporate network. An asset can be tangible (a house, a car, money, land, etc.) or intangible (patents, copyrights, trademarks, etc.). Virtually anything of value can be tracked and exchanged on a blockchain network, reducing risks and costs for all parties involved. Business is based on information. The faster it is received and the more accurate it is, the better. The blockchain is ideal for providing this information because it offers immediate, shared, and fully transparent information stored on an immutable ledger that can only be accessed by authorised network members. A blockchain network can track orders, payments, accounts, production, and more. Further, because members share a single view, it is possible to see all the details of a transaction from end to end, offering greater trust, as well as new efficiencies and opportunities. Benefits include security; the decentralization of the network with smart contracts that can streamline and optimise processes; the possibility of traceability and tracking of each asset from production to its destination market; cost reduction and transparency of transactions; and efficiency that helps achieve interoperability between participants, allowing them to access the same data at the same time.

For example, the so-called permissioned (private) blockchain has improved monitoring of transaction flows, which is particularly relevant for organizations such as tax agencies, customs, and other regulators, while the speed and certainty aspect of the technology would bring significant benefits to their day-to-day operations. This can also be an opportunity to define indicative guidelines on the regulation and use of smart contracts. With blockchain, tax authorities can prevent fraud (in the case of VAT) and interestingly and effectively allocate profit rights for the determination of a "common consolidated corporate tax base."[6] Further, regarding transfer pricing, technology can help recognize a new value to intangibles and formulate a new concept of taxation[7] by redefining the concept of a virtual permanent establishment.[8]

The idea of adopting blockchain technology presents many legal and regulatory challenges, ranging from consumer protection to combating criminal activities. However, we are facing an epoch-making breakthrough that also has enormous potential benefits for citizens themselves, including reduced costs, increased security in transactions, and a more accessible and innovative financial system, among other possibilities. These and other aspects emerged in a recent motion for a resolution [9] approved by the European Parliament, in which the broad potential of blockchain technology, "far beyond the financial sector," was highlighted;[10] European Parliament Member Lídia Pereira called for a proportionate regulatory approach as well as developing appropriate capacities and expertise at the EU level. Blockchain technology also has the potential to revolutionize systems for recording transactions and their taxation, as well as automating many of the processes that characterize today's tax systems.

Clearly, this entails a drastic rethinking of the rules and customs that constitute the traditional approach. However, given all the features of

[5] On September 24, 2020, the European Commission published a proposal for the regulation of cryptoassets: the MiCA. The proposal is part of a wide-ranging digital finance package, which also includes other documents, like a "Digital Finance Strategy," a "Retail Payments Strategy," and legislative proposals for a distributed ledger technology pilot regime and for greater "digital resilience" in the financial sector. Once adopted and in force, the MiCA will be a directly applicable law in all EU member states and will regulate all issuers and service providers dealing in cryptoassets. The MiCA European Regulation has been approved by the European Parliament in plenary session and was ratified by the Council of Europe on May 16, 2023. *See* Lanotte, "MiCA Leads the EU Digital Market's Growing Presence," *Tax Notes Int'l*, June 19, 2023, p. 1597.

[6] Lanotte, "The European Fiscal Support Plan in Response to COVID-19 (the Black Swan of European GDP): State Aid and Indirect Tax Measures," 7 *European Tax'n* (June 8, 2020). The common consolidated corporate tax base is a single set of rules for calculating the taxable profits of companies in the EU. With it, cross-border companies will have to follow a single EU system for calculating taxable income instead of different national rules.

[7] Lanotte and Fernandez-Leenknecht, *supra* note 2.

[8] Lanotte, "Action 1 and the Virtual Permanent Establishment," *ITR* (July 2019).

[9] EP, "Resolution on Distributed Ledger and Blockchain Technologies: Building Trust Through Disintermediation," 2017/2772(RSP) — tabled following question for oral answer B8-0405/2018 under Rule 128(5) of the Rules of Procedure (Sept. 24, 2018).

[10] EP, "Resolution of 26 May 2016 on Virtual Currencies," 2016/2007(INI), at "Opportunities and Risks of VCs and DLT in the Rapidly Evolving Technological Landscape of Payments" (2016).

blockchain technology examined so far, it is unsurprising that it could be used for a variety of other purposes, some of which will be discussed below. For example, regarding real-time accounting, blockchain technology has the potential to improve the accounting profession by reducing the costs of maintaining and reconciling records and making the records themselves more reliable. In a "private" blockchain scenario, for example, the typically cumbersome auditing activities could be streamlined by granting access to an external auditing firm. This would result in faster and more effective auditing processes.

In the payroll tax business, blockchain technology would allow employees to be paid — and consequently all related deductions and contributions made — in real time, and simultaneously allow various entities (especially social security and insurance entities) to have immediate access to all employee records and all payments received by them. Blockchain technology, by nature, lends itself to having a considerable effect in an implementation hypothesis in the tax system. Finally, given the complexity of intercompany transactions and the transparency obligations imposed by the various jurisdictions, automating the processes of applying and documenting a proper transfer pricing policy is clearly attractive and of considerable importance. The decentralized, cryptographic, and self-executing nature of blockchain technology applications seems to presume and rely on a self-regulatory approach that would in principle operate in parallel to classical legal instruments.

A closer look at the most sophisticated blockchain applications reveals a number of regulatory and legal issues that must be considered because they are likely to overturn certain fundamental aspects of the current reality. For instance, the decentralized and cross-border aspects of blockchain raise jurisdictional issues, being "supra-state" by nature, and create the need for an international regulatory approach rather than a local or regional one. Another order of problems arises from the use of smart contracts regarding, for example, liability and reporting issues. For example, problems may arise for consumer protection because contractual clauses may be unclear and, given their automated nature, not easily adaptable to a possible change in circumstances. At the same time, it might also be unclear which law is applicable or which court has jurisdiction over the transaction. A third set of problems is that blockchain-based systems could be exposed to co-optation by external powers and, in the absence of sufficient institutional protection, platforms could evolve into oligarchies. This situation could be exacerbated by the very cryptography on which blockchain technology is based, which could make it impossible to comply with a minimum standard of subjective rights. The fact that data in the blockchain are immutable (meaning that once entered they cannot be changed or removed) ensures transparency and accountability. However, this could also translate into risks for confidentiality and data protection, especially when it comes to personal or confidential data (which should never be stored in a blockchain). Blockchains do not guarantee anonymity, and the more personal the data is, the easier it is to identify the person to whom it refers. This immutability could compromise the right to be forgotten, whereby users can, under certain circumstances, request that their personal data be deleted. At the accounting and taxation level, blockchain is the harbinger of disruptive consequences, which would entail a revolution not just in government databases and network systems but in the entire governmental and legislative approach to taxation.[11] Nevertheless, the benefits of blockchain technology at the governmental level are hard to overlook — so much so that in the long run, blockchain could become the driving force behind the development of real-time automated tax processes capable of permanently changing taxation and the taxpayer-taxpayer relationship.

[11] Estonian e-residency (or virtual residency) is a title under which nonresident citizens can obtain an Estonian-issued digital identity, similar to the one provided to Estonian residents on their ID. A digital identity issued by Estonia, like the one provided to Estonian residents on their identity document. This entitles them to use services provided by both Estonian state agencies and the private sector usually linked to the identity document.

II. Blockchain Tech Against Tax Evasion

The EP adopted a nonbinding resolution[12] for a better use of blockchain to combat tax evasion, and for member states to better coordinate taxation of cryptocurrencies. Regarding the taxation of cryptocurrencies, the resolution states that these assets should be subject to fair, transparent, and effective taxation, and it invites the authorities to consider simplified tax treatment for small traders and small transactions. To this end, the resolution asks the European Commission to assess the different ways in which member states tax cryptoassets, identifying different national policies on combating tax evasion in this field. To do this, however, would require clear and widely accepted definitions of what cryptocurrency is and what constitutes a taxable event, so the resolution calls for the commission to comment on these aspects as well. On the other hand, to use blockchain to combat tax evasion and achieve better tax collection, the resolution states that national administrations must commit to using all possible tools to facilitate effective tax collection, identifying blockchain as one of these tools. The resolution notes that the unique features of blockchain technology can offer a new way to automate tax collection, limit corruption, and better identify the ownership of tangible and intangible assets, allowing for more effective tax frameworks. To do this, however, an effort is needed to identify best practices for the technology's use so that the analytical capacity of tax administrations can be improved, and member states should also endeavor to reform tax authorities through modernizing processes. Finally, the resolution calls on the commission to better integrate the use of blockchain in the various forums and programs dealing with taxation and cooperation.

[12] A nonbinding resolution of October 4, 2022, adopted by the EP calls on the European Commission to review the taxation of cryptocurrencies in member states and to promote the use of blockchain as an effective tax collection tool. The nonbinding resolution, tabled by Portuguese MEP Lidia Pereira of the European People's Party, was adopted in plenary with 566 votes in favor, seven votes against, and 47 abstentions. It is a resolution that establishes a framework to achieve both proposed goals of using blockchain. EP release, "MEPs Call for Using Blockchain to Fight Tax Evasion and an End to Crypto Asset Non-Taxation" (Oct. 4, 2022).

III. Innovative Use of Blockchain in Tax

The cooperative compliance regime in Italy was established by Legislative Decree No. 128 of August 5, 2015, under the heading "Provisions on Legal Certainty in Relations Between Tax Authorities and Taxpayers, Implementing Articles 5, 6 and 8, Paragraph 2, of Law No. 23 of 11 March 2014" (Legislative Decree 128/2015). Taxpayers with a system of detection, measurement, management, and control of tax risk (understood as the risk of operating in violation of tax regulations or contrary to the principles or purposes of the tax system) may adhere to it.

The objective of the Institution of Collaborative Compliance is to establish a relationship of trust between the administration and the taxpayer aimed at increasing the level of certainty on relevant tax matters. This objective is pursued through constant and preventive dialogue with the taxpayer on factual elements, including the anticipation of control, aimed at a common assessment of situations likely to generate tax risks. It is an institute that provides for the voluntary participation of the taxpayer if they meet the subjective and objective requirements set out below.

A. Subjective Requirements

In article 7 of Legislative Decree 128/2015, point 2 of the Agency Order of April 14, 2016, and Italian Ministry of Finance's Decree of January 31, 2022, the scheme is reserved:

- for the years 2022, 2023, and 2024, to resident and nonresident entities (with PEs in Italy) that realize a volume of business or revenues not less than €1 billion;[13]
- resident and nonresident taxpa yers (with PEs in Italy) with a turnover or revenue of not less than €1 billion and that have applied to join the Collaborative Compliance Pilot Project;
- companies that intend to implement the response of the Italian Revenue Agency (Agenzia delle Entrate) provided following

[13] The new entry threshold was further lowered by the Ministerial Decree of January 31, 2022. The Ministerial Decree of March 30, 2020, had already reduced the threshold for entry into the regime for financial years 2020 and 2021 from €10 billion to €5 billion.

an application for an interpellation on new investments (to article 2 of Legislative Decree No. 147 of September 14, 2015), regardless of the volume of turnover or revenues;
- to entities that are part of the VAT group of companies already admitted to the regime (Legislative Decree 119/2018), regardless of the volume of business or revenues.

In this respect, it is recalled that, according to points 2.5 and 2.6 of the measure:

- entry by "drag and drop" is allowed by the entities listed above of the resident or nonresident company with PEs in Italy that performs "steering functions" on the tax risk detection, measurement, management, and control system, even if it does not meet the size requirements; and
- if the company performing steering functions as defined above has applied for the pilot project and does not meet the size requirements, the companies belonging to the same group will have access to the scheme with the size limit of €1 billion and will in turn be able to "drag in" the company that applied.

B. Essential Requirements

Essential requirements of the tax risk control system or Tax Control Framework are found in article 4 of Legislative Decree 128/2015 and point 3 of the Order of the Director of the Revenue Agency of April 14, 2016.

Entities intending to join the collaborative compliance regime must be in possession, at the date of submission of the application, of an effective tax risk control system included in the context of the corporate governance and internal control system.[14]

The system is effective when it is able to provide the company with constant supervision of tax risks. For these purposes, the system must present the following requirements[15]:

- fiscal strategy;
- roles and responsibilities;
- procedures;
- monitoring;
- adaptability to the internal and external environment; and
- report to management bodies.

The collaborative compliance regime introduces innovation in tax relations, providing new ways of engaging in constant and preventive dialogue with the Italian Revenue Agency,[16] with the possibility of reaching a common assessment of situations likely to generate tax risks before tax returns are submitted. This provision offers the opportunity to manage situations of uncertainty through a prior discussion of factual elements that may also include the anticipation of control, and thus lends itself to preventing and resolving potential tax disputes in advance.

Article 6 of Legislative Decree 128/2015 articulates several rewarding effects for companies wishing to join the regime:

- Abbreviated procedure of preventive interpello in which the Revenue Agency undertakes to answer the companies' questions within forty-five days starting from the receipt of the application or any supplementary documentation requested.
- Application of penalties reduced by half, and in any case to no more than the minimum, with suspension of collection until the assessment is final, for risks communicated in a timely and exhaustive manner, where the Revenue Agency does not agree with the company's position.

[14] *See* OECD, "Co-Operative Compliance: A Framework From Enhanced Relationship to Co-Operative Compliance" (July 29, 2013)

[15] *See* OECD, "Co-Operative Tax Compliance: Building Better Tax Control Frameworks" (May 13, 2016).

[16] Lanotte and Lorenzo Savastano, "Will Supply Chain Evolve With the Digital Disruption?" Fintech Review (Sept. 1, 2021). The digital single market can be established on a blockchain-based network, a public "permissioned" distributed ledger in which all the stakeholders — in particular, revenue agencies, customs, peripheral tax offices, and agencies or similar — will have a defined role. Each entity will function according to its respective field of responsibilities — for example, by effectively checking and monitoring the information stream throughout the digital value chain, in matters of indirect and direct taxation. Tax or other competent authorities have the necessary information to proceed once they are transmitted. Artificial-intelligence-run mechanisms may help collect relevant information to issue tax returns or similar acts and eventually establish a profile of the taxpayer. The digital transformation of the public authorities may lift most of the tax and administrative burdens off of the external stakeholders such as companies. This considers the decentralization and tokenization of the process. The digital chain of events will bring transparency to the whole process while granting its users autonomy and security. That is in addition to cost effectiveness and time saving.

- Exemption from providing guarantees for direct and indirect tax refunds for the entire period of the regime.

IV. Distributed Ledger Technology

Blockchains (literally "chains of blocks") represent a particularly transparent and decentralized way of recording lists of transactions. A blockchain-based solution generally involves the exploitation of a platform on which participants can perform certain functions to write or read data on a distributed ledger system, whose governance and control can be decentralized — accessed by many entities connected to a peer-to-peer network.[17]

The mechanism, in very simplified terms, envisages that when an entity requests to carry out a transaction, the request is propagated throughout the network that verifies its legitimacy, placing it in a block of information awaiting validation. This process, which for public blockchains like those of bitcoin is called the independent verification process, precedes the actual validation process that will take place with the mining of the block, and it is carried out by each individual node, without yet worrying about what the others are doing at the same time (and perhaps regarding the same transactions). At this stage, each node does not worry about reaching a distributed consensus, which will happen later with the validation of the block in which the verified transactions are inserted.

The participants in the blockchain will only update their copy of the ledger with the new block validated by an entity (the so-called validating node) that obtains the trust of all, in the form of a distributed consensus achieved through adopting common rules, and thanks to a system of incentives or governance rules accepted by each entity. Each block, when validated, will be cryptographically linked to the previous node by means of a system of time stamps, thus forming a chain of validated blocks (a "blockchain," precisely). Ultimately, the blocks structured in this way will contain an ordered sequence of verified and validated transactions that have been accepted by the set of participants who have adopted the same distributed consensus protocol rules.

Blockchain is based, as mentioned, on distributed ledger technology (DLT) with the characteristic organization of data grouped into blocks of transactions, each linked to the other according to a series of chronological time stamps.

Blockchain technology comes in the following three types:

- Public, such as those hosting cryptocurrencies and requiring enormous processing power.
- Private. Companies that want a smaller network create them by granting authorizations to participants — read-only, limited transactions, and so forth — like a traditional corporate database. Note that the company must reintroduce the central authority itself, but still benefits from the blockchain's unique accuracy and transparency, potentially even allowing for real-time checks by regulators.
- Common consortiums in the banking sector, which may grant reading rights to many (or all) persons, but limit the consent mechanism to a few trusted parties, resulting in faster processing.

A blockchain-based technology also has the following characteristics:

- Distributed system: A blockchain is a system distributed over a large network of nodes whose recorded data are protected from attack because the same information is replicated, verified, and validated by adopting different protocols (or rules) commonly accepted by each entity.
- Immutability of the transcribed information: In a blockchain, recorded and validated data cannot be modified because each new piece of information is inextricably linked to the history of previous transactions; any manipulation of data would therefore be immediately highlighted, preventing subsequent validation.
- Network participation and governance permission.

[17] "Peer-to-peer" in telecommunications refers to a model of logical computer network architecture in which nodes are not hierarchised solely in the form of fixed clients or servers, but also in the form of equivalent or "peer" nodes, which are able to act as both client and server to other terminal nodes (hosts) in the network.

- Reading and writing power associated with the various users.
- Trust between network participants.
- Validation mechanism of operations.

For centuries, banks have used ledgers to keep databases of accounting transactions, and governments have used them to keep records of land ownership. Changes to transaction records are managed by a central authority, be it a bank or a government office, so that it is possible to identify who owns what at any given time. In this way, it is possible to check whether new transactions are legitimate. Because users trust that those operating the ledgers will properly verify transactions, people can buy and sell without ever having met, in the absence of mutual trust. The intermediary also controls access to the information contained in the ledger and can decide that anyone can access the identity of a building owner, but that only account holders can check the balance. These ledgers are centralized (there is an intermediary, trusted by all users, that has full control over the system and acts as a mediator in every transaction) and closed-box (the functioning of the ledger and its data are not fully visible to its users). Digitalization has made ledgers faster and easier to use, but they continue to be centralized and closed-box.

The blockchain offers the same recordkeeping functionality, but without a centralized architecture. The problem is verifying the legitimacy of a transaction without a central authority to carry out the necessary checks. Blockchains solve this problem by decentralizing the ledger, so that every user has a copy. Anyone can request that a transaction be added to the blockchain, but it will only be accepted if all users agree on its legitimacy — meaning that the request comes from the authorized person, that the seller of the property is still the owner, and that the buyer still has the necessary sum. This check is performed reliably and automatically on behalf of each user, creating a very fast and secure ledger system that is highly resistant to tampering. Each new transaction to be recorded is combined with other new transactions to form a block, which is added as the latest link in a long chain of chronological transactions. This forms the blockchain ledger held by all users. This work is called mining. Anyone can become a miner and compete to be the first to solve the complex mathematical problem of creating a valid, encrypted block of transactions to add to the blockchain. There are several ways to encourage people to undertake this task. Adding a new block to the blockchain means updating the ledger held by all users. Users accept a new block only after all its transactions have been verified. If a discrepancy is detected, the block is rejected. Otherwise, the block is added and will remain in the chain as a permanent public record; no user can remove it. To destroy or damage a traditional ledger, it is necessary to attack the intermediary, but for a blockchain, every copy of the ledger must be attacked simultaneously. A "fake ledger" cannot exist, because all users are in possession of an authentic version that they can use for comparison.

Trust and control in blockchain-based transactions are not centralized and closed-box, but decentralized and transparent. These blockchains are defined as permissionless because there is no special authority that can deny someone permission to participate in the control and addition of transactions. It is also possible to configure permissioned blockchains, in which a limited group of actors have the power to access, control, and add transactions to the ledger. In this way, traditional actors like banks and governments can retain substantial control over their blockchains. Blockchains with authorizations are less transparent and decentralized than their counterparts without authorizations, and therefore embody somewhat different social and political values. Ledgers have several innovative and interesting functions compared with centralized ledgers. However, in addition to recording the date, time, and transaction details, they can play a more active and potentially autonomous role in the management and execution of transactions. By embedding code in the blockchain, transactions can be executed automatically when certain conditions are met, thus providing an "execution guarantee."

Traditional Contracts vs. Smart Contracts

Traditional Contracts	Smart Contracts
Large quantity of printed documents	Wholly digital documents
One must rely almost exclusively on third parties, judicial authorities, banks, and/or national authorities for it to be valid	It is self-executing because the will of the parties is expressed in the form of digitally preset instructions
In the event of nonenforcement, there will be a need to turn to the judicial system	The code itself defines the obligations of the parties

Smart contracts[18] with automatic execution, based on this functionality, are being rapidly developed. A smart contract is the translation or transposition into code stored in a blockchain of the elements of a contract, so that the fulfilment of certain conditions (control of basic contract data) is automatically verified, followed by the realization of predetermined effects. The term "smart contract," however, can be misleading, because even regarding the differences in the various regulatory systems, in some cases it is not possible to speak of contracts in a strictly legal sense, but in the sense of "if/then" functions embedded in software or computer protocols. For example, *if* there is a deadline, *then* payment starts. In other words, through smart contracts there can also be a computerized transposition of agreements that are concluded outside the technological platform.

For example, in the case of a smart contract relating to the purchase and sale of products, the obligation to deliver the goods and the related obligation to pay by bank transfer would be recorded on the blockchain; once the delivery of the goods is recorded, thanks to the technology under consideration, the instruction to the bank to make the payment would be automatically activated. This instruction could, in turn, trigger other instructions in other smart contracts, relating, for example, to currency exchange or the placing of other orders further down the supply chain.

Because the blockchain ledger is immutable, the agreed code (and thus the agreed contract) can only be canceled or modified within the terms already allowed by the code. Traditional contracts allow a choice between paying what is owed under the contract or terminating the contract with the resulting consequences, including legal action. However, if payment is automated within the framework of a smart contract, this choice is no longer possible because the transaction is performed automatically.

V. A Decentralized 'Digital Single Market'

Blockchain, a form of DLT, has the potential to transform tax and financial interactions between taxpayers and tax administrations by simplifying complex processes, ensuring faster execution of transactions, improving transparency, creating auditable operations, and lowering costs after the initial implementation phase. Its applications could even include introducing a "digital euro." The creation of a digital single market[19] can empower all relevant parties thanks to the implementation of a large-scale, groundbreaking system that offers benefits in the form of fairer taxation, efficient reporting tools, transparent and streamlined information, and the capacity for precise calculation of taxes. The digital single market can be established on a blockchain-based network — specifically, a DLT[20] in which all the

[18]Smart contracts: The decentralized ledger (the blockchain) can be used through smart contracts, otherwise known as self-executing contracts, blockchain contracts, or digital contracts. Thus, contracts can be converted into computer code, stored and replicated on the system, and supervised by the network of computers running the blockchain. Smart contracts are essentially agreements in the form of computer programs in which the terms and conditions can be programed, designed to self-execute. Like blockchain technology, the basic objective of a smart contract is to remove the need for an intermediary, allowing anonymous parties to conduct business over the internet.

[19]Eurostat, "What Is the Digital Single Market About?" (June, 2018).

[20]Blockchain is a form of DLT in which transactions are conducted in a peer-to-peer fashion and then broadcast to the entire set of system participants, all or some of which work to validate them in batches known as blocks. *See* IOTA, "EBSI — Building a Distributed Ledger Technology for Europe" (Sept. 7, 2021).

stakeholders (including revenue agencies, customs, peripheral tax offices, and other agencies) will have defined roles. Each entity will function in line with its respective field of responsibilities — for example, by giving consensus (that is, by effectively checking and monitoring the streamlined information in the digital value chain) in matters of indirect and direct taxation. Key issues include identifying and defining the market, access and exit points on the value chain, and the target data needed for tax purposes. Tax or other competent authorities thus receive necessary data, which is transmitted by counterparties via the blockchain.[21] Artificial-intelligence-run mechanisms can help collect relevant information to issue tax returns or similar acts and can eventually establish a profile of the taxpayers. Because of the resulting decentralization, the digital transformation of the public authorities may alleviate most of the tax and administrative task burdens for external stakeholders, including companies. In addition to being cost effective and time saving, the digital chain will bring transparency to the entire tax process while granting its users autonomy and security. Innovative ompanies and multinational enterprises are also moving items of value across blockchain networks. The process of tokenization — that is, converting the rights to an asset into a digital token within a blockchain, with one token representing an intangible asset or a defined portion thereof — plays a considerable role in the exchange of information.[22]

For example, using blockchain to issue digital invoices allows value-embedded assets to be sent across multiple network participants, ensuring that all parties receive the same information at the same time. Everything is recorded on the distributed and decentralized ledger, which increases trust and transparency between counterparties. Lifting responsibilities from the companies that have been granted access to a public and permissioned blockchain allows both taxpayers and tax authorities to focus on their respective businesses and obligations. They can also anticipate their future objectives and projects by using smart contracts.

VI. Concluding Remarks

The blockchain is a DLT because it is based on a technology that minimizes errors, increases efficiency, and reproduces individual movements (blocks) in an up-to-date, chronological sequence. Blockchain also identifies the concepts of trust, responsibility, and community as its preeminent features. Alongside these are features like encryption, transparency, sharing, and competition to achieve a result. Finally, there are other characteristics, like the immutability of data over time and the decentralization that underpins innovation — not only technological — that is not only powerful and complex but also democratic and extraordinarily revolutionary.

Within a complex system like taxation, blockchain can offer the ability to provide reliable information in real time to a large group of people. This would create a system in which both taxpayers and tax authorities have equal confidence in the veracity of the data collected — a feature inherent to blockchain.

According to the EU General Data Protection Regulation (GDPR),[23] there is an underlying assumption that for each piece of personal data in a system, there must be at least one natural or legal person who serves as the data controller. Data subjects have the right to approach this data controller to enforce their rights under EU data protection law. Data controllers are obligated to adhere to the requirements set forth in the GDPR. Blockchains, on the other hand, are decentralized databases that typically aim to achieve these requirements by replacing a single central authority with multiple participants or entities. There is a lack of agreement on how joint controllership should be defined, which makes it challenging to determine and assign responsibility. Further, the GDPR operates on the assumption that data can be altered or deleted when required to meet legal obligations, as outlined in articles 16 and 17 of the GDPR. Blockchains, in contrast, deliberately make it

[21] Thailand's tax agency is implementing blockchain in VAT refunds.

[22] *See* Lanotte, "The Tokenization of Assets for a Decentralized Future in Europe," *Tax Notes Int'l*, Feb. 20, 2023, p. 987.

[23] Intersoft Consulting, "General Data Protection Regulation" (May 25, 2018).

difficult to unilaterally alter data, which maintains data integrity and enhances trust within the network. Also, blockchains highlight the difficulty of meeting the demands of data minimization and purpose limitation in the data-driven economy.

To some extent, the GDPR needs to be modified to include the latest disruptive technologies like blockchain, AI, or quantum technology; it is impossible to accomplish the reverse because the technology will always be a step or two ahead of legislation. The next step will be to add or further develop the concept of digital identity, which will become more standard in a WEB 3.0[24] scenario in what is called a dynamic informed digital consent in the zero-knowledge proof described below.

A. Dynamic Informed Digital Consent

There is another critical consideration in the context of blockchain-based solutions: Blockchain technology can provide individuals with greater control over their personal data, enabling them to manage and share their data transparently and ethically. Smart contracts and other blockchain-based tools can enable individuals to specify the terms and conditions under which their data is shared. A digital ID would give citizens a personal wallet through which they can access public services, by using zero-knowledge proof technology,[25] which reveals only the necessary data in a transaction to protect users' privacy. The Electronic Identification and Trust Services 2 regulation must be future-proof and able to support the societal and economic developments that have recently emerged. Among these are electronic ledgers, which provide an innovative addition to the trust service landscape.[26]

A zero-knowledge proof is a method by which one party (the prover) can prove to another party (the verifier) that something is true without revealing any information beyond that the specific statement is true. In this light, Web 3.0 will become a human-centric trust machine — an open and decentralized gate to the metaverse, publicly accessible and (in some cases) privately designed, in which tokens represent the keys to access and interact with it, producing social, economic, and political effects.

Zero-knowledge proofs have transformative implications for privacy and security in the digital world. They can validate statements without sharing sensitive information, revolutionizing fields like cryptocurrencies, data privacy, and identity management. The core concept is knowledge without disclosure. Zero-knowledge technology is a subset of cryptography that helps blockchain projects overcome the scaling and privacy limitations inherent to many layer-1 blockchains. This technology enables blockchain projects to facilitate greater transaction throughput, protect user data without losing the ablity to verify identities, and support complex computation, while also allowing enterprises to adopt blockchain technology without risk to their intellectual property. ■

[24] Web 3.0 is the name some technologists have given to the idea of a new kind of internet service built using decentralized blockchains — the shared ledger systems used by cryptocurrencies like Bitcoin and Ether. *See* Kevin Roose, "The Latecomer's Guide to Crypto," *The New York* Times, Mar. 18, 2022.

[25] Use of zero-knowledge proof technology for identification purposes. This technology can serve as the "notary on the blockchain" and can guarantee the identities behind the transactions. *See* European Parliament, "Use of Zero-Knowledge Proof Technology for Identification Purposes," Parliamentary Question E-005174/2021.

[26] *See* International Association for Trusted Blockchain Applications, "Open Letter for the Preservation of the Electronic Ledger's Provisions in eIDAS 2" (Mar. 13, 2023).