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Can Blockchain Revolutionize Tax Administration?

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ABSTRACT

Experts predict that the use of smart contracts and other applications of blockchain technology could revolutionize the manner in which we do business. Blockchain technology promises the elimination of middlemen, increased trust and transparency, and improved access to shared information and records. Thus, it is no surprise that companies and entrepreneurs are developing blockchain solutions for an array of markets, ranging from real estate to health care. But can this new technology revolutionize tax administration?

This Article is the first to consider blockchain technology's role in addressing the shortcomings of our current administration system—namely, a large tax gap, high compliance and administrative costs, and operational inefficiencies. To mitigate these problems, this Article introduces two innovative uses of blockchain technology in the tax space: a blockchain-based platform for information returns and a blockchain-based platform for digital invoices. Implementing these blockchain-based platforms for tax administration presents significant opportunities to digitalize and automate certain tax processes, improve tax compliance and enforcement, and minimize many inefficiencies currently involved in the tax administration process.

This Article also considers the broader implications of using technology to improve tax administration by demonstrating that any

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blockchain tax initiative is unlikely to make meaningful improvements to tax processes without additional government action. It, therefore, sets forth normative steps for policymakers to take in supporting the use of blockchain and other technologies in the tax space. By doing so, this Article promotes a proactive approach to exploring and understanding blockchain technology's benefits, limitations, and implications to ultimately place the government in the best position to modernize our tax administration system.

Table of Contents

I. INTRODUCTION

The unprecedented rise of blockchain—the latest technological buzzword—has resulted in high expectations regarding the potentially revolutionary uses of the technology. Blockchain promises to disrupt entire industries, reshape the economy, and fundamentally transform how businesses, people, and governments operate. More specifically, blockchain enthusiasts anticipate a future where intermediaries and middlemen are eliminated from transactions of every kind. In this new world, multiple parties that do not know each other can securely and directly transact with each other, giving rise to significant cost savings, transparency, and other benefits.

But can this new technology revolutionize tax administration? Efficiently and effectively collecting taxes and enforcing the tax laws has been a serious, ongoing problem for tax authorities worldwide and a topic of discussion by policymakers, scholars, and economists, among others.[1] Despite numerous measures implemented, the tax gap—the difference between a taxpayer's true tax liability and the amount of tax collected—remains a significant concern.[2] Information asymmetry, the tax system's complexity, taxpayers' compliance burdens, tax administration costs, and diminished Internal Revenue Service (IRS) resources, among other factors, all contribute to this growing problem.[3]

Blockchain technology could help. Blockchain technology is a secure, distributed Internet-based ledger. Although it is best known for its use in the creation of Bitcoin and other virtual currencies, it has broader applications. In particular, through the use of a cryptographically encrypted distributed ledger with a consensus process to validate transactions, blockchain technology has the potential to securely record and share information about anything that has value. It uses economic incentives to motivate users to verify the authenticity of transactions, thereby facilitating the peer-to-peer exchange of value and increasing the

1. *See generally* Joel Slemrod, *Tax Compliance and Enforcement* (Nat'l Bureau of Econ. Rsch., Working Paper No. 24799, 2018); U.S. GOV'T ACCOUNTABILITY OFF., GAO-19-558T, TAX GAP: MULTIPLE STRATEGIES ARE NEEDED TO REDUCE NONCOMPLIANCE 7 (2019), https://bit.ly/3crtVjI.

2. *See* BARRY W. JOHNSON ET AL., I.R.S., FEDERAL TAX COMPLIANCE RESEARCH: TAX GAP ESTIMATES FOR TAX YEARS 2011–2013, 4–5 (2019), https://bit.ly/3aN6iSg; James Alm & Jay A. Soled, *W(h)ither the Tax Gap?*, 92 WASH. L. REV. 521, 527–28 (2017).

3. *See infra* Part I.

availability of verified transactions.[4] Blockchain technology also facilitates the automation of certain processes by enabling the development of "smart contracts," which are executable code that act only if specific conditions within the blockchain are met. Combined with the other elements of the blockchain structure, smart contracts can automate trusted activity among participants, such as authorized information exchanges and payment transfers.

In short, through the use of these and other features, blockchain technology can potentially improve the integrity and reliability of transactions by ensuring that verified transactional tax data has not been modified; increase the transparency of transactions among multiple parties by allowing the tax authorities and taxpayer to access the same information; and improve the efficiency of a network by minimizing data redundancies—all without the involvement of an intermediary. Furthermore, multiple counterparties can interact directly with blockchain technology while reducing administrative burdens, labor-intensive processes, duplicative efforts, and transactional costs.[5] These attributes of blockchain technology could improve the tax system by providing tax authorities and taxpayers with access to tax-related data and automated processes which could be used to bolster enforcement efforts, minimize taxpayers' record-keeping and tax compliance burdens, and ultimately reduce the tax gap.[6] This raises an important question: should governments use blockchain technology in the tax sector?

Despite the expansive literature on blockchain and the growing necessity to modernize the tax administration system, the question of how to apply blockchain to the tax sector remains significantly underexplored.[7] Moreover, the question of whether the technology can

4. Note that this is not without limitations. Although blockchain technology enables users to validate transactions, the technology cannot be used to validate the underlying data when the data is not native to the blockchain.

5. *See* JAMES SCHNEIDER ET AL., GOLDMAN SACHS GRP., INC., BLOCKCHAIN: PUTTING THEORY INTO PRACTICE 3 (2016), https://bit.ly/3PzVUf2.

6. *See* Jeffrey Owens & Julia de Jong, *Taxation on the Blockchain: Opportunities and Challenges*, 87 TAX NOTES INT'L 601, 602 (2017).

7. The limited scholarship discussing blockchain's potential role in the tax space generally considers the use of blockchain-based applications to improve particular tax systems, rather than how to utilize blockchain to improve the tax administration system more broadly. *See, e.g.*, Richard T. Ainsworth, Musaad Alwohaibi, & Mike Cheetham, *A High-Tech Proposal for the U.K. and Saudi-VATs: Fighting Fraud with Mini-Blockchains and VATCoins*, 96 TAX NOTES INT'L 511, 526–39 (2019) (proposing a blockchain-based application to improve the VAT system) [hereinafter Ainsworth, Alwohaibi, & Cheetham, A High-Tech Proposal]; RICHARD T. AINSWORTH & VILLE VIITASAARI, B.U. SCH. OF L., PAYROLL TAX AND THE BLOCKCHAIN 20–31 (2017), https://bit.ly/3v1Itgi (discussing blockchain's potential role in the payroll tax system); Young Ran (Christine) Kim, *Blockchain Initiatives for Tax Administration*, 69 UCLA L. REV. (forthcoming 2022) (summarizing a few proposed blockchain initiatives in the tax space).

provide transformational benefits to our current system is not yet addressed.[8] This Article seeks to fill the gap in the scholarship by analyzing whether blockchain technology can transform key aspects of our tax administration system as well as the challenges that must be overcome before the technology can be incorporated into the tax space. Through its analysis, this Article makes four key contributions to the growing scholarship surrounding the use of blockchain in the public sector.

First, this Article demonstrates why blockchain's core features can provide valuable benefits to tax administration.[9] In particular, blockchain technology facilitates greater levels of trust, transparency, and efficiency in data management and processing. Each of these features represents a vital component of a modern tax administration system. For instance, without trust that the data and processes used to compute a taxpayer's liability are accurate, the tax system cannot function effectively. This is because taxpayers need assurance that they are paying the correct amount of taxes and governments need assurance that the correct amount of taxes are being paid. Similarly, transparency of transactions is essential to addressing a tax authority's information constraints in performing its assessment and verification functions, narrowing the tax gap, and minimizing taxpayers' compliance burdens. Furthermore, tax administration systems also require efficiency to maximize the tax authority's and taxpayers' limited money, time, and other resources.

Second, this Article contributes to the existing blockchain literature by introducing two innovative examples of potential blockchain-based tax applications that could significantly improve the current tax administration system.[10] The first proposed tax application is to use blockchain technology to implement a blockchain-based platform for information reporting. In other words, this use of the technology would allow parties to share tax-related data—such as W-2s, interest income, dividend income, and other reported income—in a single, logical, and secure location. The second, broader application of the technology extends beyond information reports to build a transparent, unified database that collects, aggregates, and reliably shares transactional data. This blockchain-based database could serve as a secure platform that collects and shares verified transactional data related to a particular tax

8. The existing scholarship in the tax field also fails to account for the substantial developments, outside of the blockchain technology itself, that would need to occur before a blockchain tax initiative could generate meaningful results. *See, e.g.*, *supra* note 7.

9. *See infra* Section III.A.

10. *See infra* Section III.B.

regime, such as the value added tax (VAT), the U.S. sales tax, or payroll tax.

Through these applications, blockchain could optimize current tax reporting processes. It would do so by (i) using the technology to acquire and seamlessly share access to third-party information reports and other tax-related transactional data among all authorized parties, (ii) automating a portion of the tax return preparation process by pre-populating a taxpayer's tax return with this information, and ultimately, (iii) facilitating real-time access to this tax data.

Third, this Article contributes to the burgeoning scholarship in this field by highlighting blockchain's current limitations and how the limitations could hinder the adoption of any type of blockchain-based tax solution. It demonstrates that the biggest obstacles to adopting a blockchain-based tax initiative extend beyond mere technological limitations. Thus, this Article makes an additional significant and novel contribution in this area by setting forth a normative framework that policymakers should take to develop the groundwork that could eventually facilitate the adoption of blockchain—as well as other emerging technologies—in the tax space. These measures include (i) developing a regulatory framework and standards to minimize legal risks and improve system interoperability, (ii) adopting a uniform digital identity system, a digital invoice system, and tokenized currency to maximize blockchain's potential benefits, and (iii) engaging in blockchain-related research and education to develop appropriate use cases and identify the true value, limitations, and implications of using blockchain and other technologies in the tax space. [11]

Finally, this Article also makes the important argument that blockchain technology is not a panacea. Blockchain and other technologies will not significantly improve tax administration without a more fundamental rethinking of the entire tax system. Nevertheless, it is essential that policymakers continue their involvement in the development of blockchain and other promising technologies. Doing so provides government agencies with an opportunity to reexamine the potential role technology can play in digitalizing the tax administration system and modernizing the current aging technological infrastructure.

The remainder of this Article proceeds as follows: Part I provides an overview of our current system of tax administration and its challenges. It focuses on the primary challenges that tax authorities face in effectively and efficiently collecting taxes and enforcing the law. Part II explains the mechanics behind blockchain, highlights its core innovations, and describes several non-tax applications. Part III

11. *See infra* Part IV.

demonstrates how blockchain has tremendous potential to help modernize the tax administration system. It identifies blockchain's most compelling benefits and explores how the technology's core attributes can be harnessed to improve the current system. Part IV describes blockchain's current challenges and limitations and suggests steps policymakers should take to support blockchain's development in the tax space. In making these recommendations, this Article also highlights the importance of harnessing technological advancements to further digitalize our predominantly manual tax systems and demonstrates how blockchain technology can be a powerful tool to achieve this goal.

II. PROBLEMS WITH CURRENT SYSTEM OF TAX ADMINISTRATION

"All [tax authorities] have essentially the same set of overarching goals—to collect more tax, and to collect it more efficiently."[12] To achieve these goals, a good tax administration system requires a high degree of trust, transparency, and administrative simplicity.[13] However, due to shortcomings in these areas, our current system of tax administration results in a large tax gap and involves many costs and inefficiencies. This Part highlights some of the major problems with our current system of tax administration.

A. The Tax Gap

In its most recent report, the IRS estimated that the annual amount of noncompliance with our tax laws is approximately $381 billion after IRS enforcement efforts are taken into account.[14] This number represents the average net tax gap, or the difference between what taxpayers are obligated to pay (taxpayers' true tax liability) and the amount of tax taxpayers actually pay.[15] As a result, 14.2% of all individual and corporate income taxes, employment taxes, estate and gift taxes, and excise taxes owed go unpaid.[16]

12. CHANNING FLYNN ET AL., EY, TAX ADMINISTRATION GOES DIGITAL 1 (2017), https://go.ey.com/3ziOqIh.

13. *See* ALLAN THIRD ET AL., KNOWLEDGE MEDIA INSTITUTE OF THE OPEN UNIV., GOVERNMENT SERVICES AND DIGITAL IDENTITY 4 (2018), https://bit.ly/3PECwxB.

14. *See* JOHNSON ET AL., *supra* note 2, at 7. This report is based on taxpayer noncompliance in tax years 2011, 2012, and 2013. The gross tax gap, which only includes timely tax payments made by taxpayers voluntarily, is $441 billion during that same time period. *See id.* This means that only 83.6% of all individual and corporate income taxes, employment taxes, estate and gift taxes, and excise taxes that are owed are paid. *See id.* This tax gap is comprised of three components: non-filing, underreporting and underpayment, with underreporting representing the largest driver of noncompliance. *See id.* at 9, 11–12. The actual amount of taxpayer noncompliance also varies by type of tax, with noncompliance highest for individual income taxes. *See id.* at 8.

15. *See id.* at 4.

16. *See id.* at 7.

The considerable magnitude of the tax gap indicates the critical need to improve compliance rates. Resolution of this issue has significant importance because minimizing the tax gap is essential to raising revenue, maintaining the integrity of the tax system, and minimizing unfair competitive advantages among similarly situated taxpayers.[17] This issue is not new; Congress has implemented numerous measures throughout the years to address the tax gap, with varying degrees of success.[18]

Many factors contribute to the tax gap. Three especially important factors include: (i) the information constraints under which the government operates, (ii) the complexity of the Internal Revenue Code, and (iii) the inadequate resources of the IRS.[19] To adequately administer the tax system, tax authorities need access to trustworthy tax-related data to ensure that taxpayers are complying with their tax obligations. To acquire this data, tax administrators primarily rely on taxpayers to self-report their taxable income. Because a lot of this information is non-verifiable by the government without costly auditing measures, this puts tax authorities at a disadvantaged position. Improving the trust, transparency, and efficiency of the tax administration system can help mitigate the negative effects of these issues.

Currently, information reporting is required for many types of payments, such as salaries, wages, dividends, premiums, interest, share sales, and real estate sales, to minimize the information asymmetry created by this situation.[20] Having third parties provide year-end information statements to both the tax authority and the private parties with whom they have transacted improves the visibility of the transaction, provides a means of verifying the amount of reported taxable

17. *See* Alm & Soled, *supra* note 2, at 527–28.

18. A review of the extensive tax compliance literature is beyond the scope of this Article. For an introduction, *see generally* James Andreoni et al., *Tax Compliance*, 36 J. ECON. LIT. 818 (1998); Slemrod, *supra* note 1; Leandra Lederman, *Reducing Information Gaps to Reduce the Tax Gap: When is Information Reporting Warranted?*, 78 FORDHAM L. REV. 1733 (2010); Natasha Sarin & Lawrence H. Summers, *Shrinking The Tax Gap: Approaches and Revenue Potential* (Nat'l Bureau of Econ. Rsch., Working Paper No. 26475, 2019).

19. *See* U.S. GOV'T ACCOUNTABILITY OFF., *supra* note 1, at 7; *see also* STAFF OF THE JOINT COMM. ON TAX'N, JCX-19-19, OVERVIEW OF THE TAX GAP 4–5 (2019), https://bit.ly/3ISnl1D.

20. *See, e.g.*, I.R.C. § 6041 (applying special reporting rules for certain payments of $600 or more made to another person in the course of a trade or business); I.R.C. § 6042 (applying special reporting rules for dividends and corporate earnings and profits); I.R.C. § 6044 (applying special reporting rules for patronage dividends); I.R.C. § 6047(e) (applying special reporting rules for trust and annuity plans); I.R.C. § 6049 (applying special reporting rules for interest); I.R.C. § 6050N (applying special reporting rules for royalties).

earnings, and minimizes the tax authority's current information constraints.[21]

However, third-party reporting is not always feasible, in which case the transparency of certain transactions substantially diminishes. In these circumstances, it often becomes more difficult for the government to ensure compliance with the tax laws.[22] Thus, transactions and sources of income that are less visible to the IRS—such as cash and self-employment income—are frequently underreported for income tax purposes and comprise a significant portion of the tax gap.[23]

Moreover, many of these information constraints are exacerbated when taxable transactions occur on an international level. The growth of cross-border activities contributes to difficulties that authorities are already experiencing in acquiring verifiable information on taxpayer activity and effectively taxing that activity.[24] The government requires some information reporting on certain cross-border payments,[25] and automatic information exchange regimes also exist. Both of these measures improve the visibility of certain assets and transactions.[26] However, these reporting requirements are limited and there is no global information system that enables tax authorities to verify the origin of cross-border economic activity.[27] As a result, the lack of trust and transparency with this information frequently contributes to opportunities for tax avoidance and evasion.[28]

The tax system's complexity also leads taxpayers to either intentionally or unintentionally make errors in computing their tax liability.[29] Although this complexity is often necessary to minimize tax avoidance or target certain policy goals, it also increases a taxpayer's compliance burden, thereby further contributing to inefficiencies in tax administration, as well as the tax gap.

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21. *See* Lederman, *supra* note 18, at 1736–39.

22. *See id.* at 1738.

23. *See id.*; JOHNSON ET AL., *supra* note 2, at 11.

24. *See Understanding the Tax Gap and Taxpayer Noncompliance: Hearing Before the H. Comm. on Ways & Means*, 116th Cong. 6–7 (2019) (statement of J. Russell George, Treasury Inspector Gen. for Tax Admin.).

25. For instance, certain types of payments, such as interest, dividends, royalties, and rental income that are made to nonresident taxpayers are subject to a withholding tax, which requires a third party to provide tax-related information and remit the appropriate tax related to the transaction. *See* I.R.C. §§ 1441–1443.

26. *See* Press Release, OECD, Implementation of Tax Transparency Initiative Delivering Concrete and Impressive Results (June 7, 2019), https://bit.ly/3N4YPM1.

27. *See* Michał Robert Hoffman, *Can Blockchains and Linked Data Advance Taxation?*, *in* WWW '18 COMPANION: THE 2018 WEB CONFERENCE COMPANION 1179, 1179 (ACM ed., 2018), https://bit.ly/3NGIwoH.

28. *See* SANJEEV GUPTA ET AL., INT'L MONETARY FUND, DIGITAL REVOLUTIONS IN PUBLIC FINANCE 25 (Sanjeev Gupta et al. eds., 2017), https://bit.ly/3zjmlk7.

29. *See* U.S. GOV'T ACCOUNTABILITY OFF., *supra* note 1, at 11.

Non-compliance is often related to the perceived probability of audits and appropriate penalties, among other factors.[30] Due to the information constraints described above, governments must use costly methods if they want to verify a taxpayer's reported information.[31] Unfortunately, the IRS often lacks resources to detect, prosecute, and adequately enforce the tax laws, which negatively affects both the rate of tax collection and the perception of the risks of noncompliance.[32]

B. Tax Administration Costs

For anyone that has tried to compute their tax liability and file their own tax return, it would be no surprise to discover that administering our system of tax administration requires a lot of time, money, and resources. The current system is complex, bureaucratic, and labor-intensive.

Under the U.S. tax system, individuals are required to file income, estate, and gift tax returns. Businesses generally file business-related tax returns, such as corporate income tax returns, partnership information returns, or sales tax returns, and may also be required to file and collect payroll and personal income taxes, in addition to other returns. Complying with these tax reporting obligations requires taxpayers to acquire and maintain adequate records and to spend time accurately transferring those records onto the various required returns or to employ software or professional tax preparers to assist with the filings.[33]

Tax authorities also incur significant costs in administering the tax system as they perform taxpayer registration, record-keeping, tax return assessment and verification, tax collection, and dispute resolution functions, in addition to providing taxpayer services and fulfilling other roles.[34] Many of these functions involve significant inefficiencies and time-consuming processes. In addition, due to the information asymmetries described above, governments are unable to target many forms of non-compliance in real-time, but instead must implement costly auditing and enforcement mechanisms after the return has been submitted.[35] With limited resources, tax authorities generally have to

30. *See id.*; STAFF OF THE JOINT COMM. ON TAX'N, *supra* note 19, at 7–8; *Understanding the Tax Gap and Taxpayer Noncompliance: Hearing Before the H. Comm. on Ways & Means*, 116th Cong. 2 (2019) (statement of J. Russell George, Treasury Inspector Gen. for Tax Admin.).

31. *See* Lederman, *supra* note 18, at 1738; Alm & Soled, *supra* note 2, at 555.

32. *See* Alm & Soled, *supra* note 2, at 529.

33. *See generally* SEBASTIAN EICHFELDER & FRANÇOIS VAILLANCOURT, TAX COMPLIANCE COSTS: A REVIEW OF COST BURDENS AND COST STRUCTURES (2014), https://bit.ly/3csRPLq.

34. *See* ORG. FOR ECON. COOP. AND DEV., TAX ADMINISTRATION 2019: COMPARATIVE INFORMATION ON OECD AND OTHER ADVANCED AND EMERGING ECONOMIES 74 (2019), https://bit.ly/3l3CdPL [hereinafter OECD].

35. *See id.* at 83.

focus their enforcement efforts primarily on the aspects of tax compliance and evasion that generate the most tax revenue, which further limits the overall effectiveness of these methods.[36]

Moreover, with the growing complexity of our tax code, these compliance and tax administration costs continue to increase.[37] As new business models emerge, new complexities are introduced into both our tax laws and into complying with the laws. As an example, the rapid emergence of both the gig economy and cloud computing have been linked to increased costs in both administering and complying with the tax system.[38] Additionally, new financial instruments, such as cryptocurrencies, present similar challenges. And as society continues to shift to a global, digital economy, both taxpayers and tax authorities are likely to see a continued increase in compliance costs.[39] In this global economy, taxpayers are regularly subject to the tax laws of multiple jurisdictions, thereby increasing the time and resources necessary to comply with the tax laws.[40] At the same time, tax authorities must expend additional resources to adapt their current systems to ensure that these transactions do not escape taxation in the appropriate jurisdiction.[41]

Some progress has been made to improve the effectiveness and efficiency of our system of tax administration. For instance, the use of electronic filings and payments by taxpayers are a great first step.[42] Electronic filings and payments can decrease a taxpayer's compliance time and allow governments to more easily use the data captured by these returns for assessment and audit purposes.[43] An increased use of cognitive capabilities, such as artificial intelligence, to target tax evasion is another promising use of technology to improve tax assessment

36. *See* Sunita Lough, *IRS Audit Rates Significantly Increase as Income Rises*, IRS (Oct. 20, 2020), https://bit.ly/3RBAy33.

37. *See* EICHFELDER & VAILLANCOURT, *supra* note 33, at 29.

38. *See generally* TREASURY INSPECTOR GEN. FOR TAX ADMIN., DEP'T OF THE TREASURY, REFERENCE NO. 2019-30-016, EXPANSION OF THE GIG ECONOMY WARRANTS FOCUS ON IMPROVING SELF-EMPLOYMENT TAX COMPLIANCE (2019), https://bit.ly/3N5VvzP; CAROLINE BRUCKNER, KOGOD TAX POL'Y CTR., SHORTCHANGED: THE TAX COMPLIANCE CHALLENGES OF SMALL BUSINESS OPERATORS DRIVING THE ON-DEMAND PLATFORM ECONOMY (2016), https://bit.ly/3983TjI; Orly Mazur, *Taxing the Cloud*, 103 CALIF. L. REV. 1, 11–12 (2015).

39. *See* EICHFELDER & VAILLANCOURT, *supra* note 33, at 29; OECD, *supra* note 34, at 78.

40. *See* Rifat Azam & Orly Mazur, *Cloudy with a Chance of Taxation*, 22 FLA. TAX REV. 500, 520 (2019).

41. *See* OECD, *supra* note 34, at 78–79.

42. *See id.* at 79.

43. *See id.*

functions.[44] Other technological solutions have been put in place with varying degrees of success.

However, one area that remains underexplored is the use of blockchain technology to improve the degree of trust, transparency, and efficiency involved in our tax administration system. As illustrated above, minimizing information constraints and streamlining tax administration processes can assist minimization of the tax gap, lower the costs and burdens of tax administration, and, ultimately, improve the effectiveness of our current system of tax administration. As this Article demonstrates, blockchain technology is a promising technology that has the potential to help achieve these goals by helping to address some of these issues.[45]

III. THE FUNDAMENTALS OF BLOCKCHAIN

Broadly speaking, blockchain is a type of distributed, digital ledger or database that is shared across a network and aggregates transactions into chains or blocks.[46] In other words, blockchain is a method of tracking transactions. Instead of having a centralized party authorize the transactions that are added to a centrally controlled database, the technology itself authorizes and adds transactions to the database. It does so by setting the "rules that enable networked computers to track transitions in the global state of recorded data . . . ."[47] Blockchain technology also manages the database to ensure that no modifications are made to the information stored on the ledger.[48] This is generally all done behind the scenes and is not visible to the participant seeking to view or add a transaction to the ledger.[49]

In the past few years, blockchain technology has experienced an unprecedented rise in popularity, with its promise to disrupt entire

44. *See* Sachin Waikar, *How an Active Learning System Can Help Close the U.S. Tax Gap*, STANFORD UNIV. HAI (Aug. 6, 2020), https://stanford.io/3RDZ9Ed.

45. *See infra* Part III.

46. *See* KURALAY BAISALBAYEVA ET AL., PWC, BLOCKCHAIN FOR TAX COMPLIANCE 12 (2019), https://pwc.to/3FyyOSs; MATTHEW HANCOCK & ED VAIZEY, GOV'T OFF. FOR SCI., DISTRIBUTED LEDGER TECHNOLOGY: BEYOND BLOCK CHAIN 17 (2016), https://bit.ly/3w5KCZn.

A common misconception is that blockchain is Bitcoin. However, Bitcoin, a cryptocurrency, is an application of blockchain technology. Other applications of blockchain technology are potentially possible. *See* BRANT CARSON ET AL., MCKINSEY & CO., BLOCKCHAIN BEYOND THE HYPE: WHAT IS THE STRATEGIC BUSINESS VALUE? 3 (2018), https://mck.co/3w1oWNY.

47. *See* Carla L. Reyes, *Creating Cryptolaw for the Uniform Commercial Code*, 78 WASH. & LEE L. REV. 1521, 1538 (2022).

48. *See* GUPTA ET AL., *supra* note 28, at 176.

49. *See* MANAV GUPTA, BLOCKCHAIN FOR DUMMIES 18 (Carrie A. Burchfield et al. eds., 2d ed. 2018), https://ibm.co/3OfVxoV [hereinafter BLOCKCHAIN FOR DUMMIES].

industries and transform many areas of our lives.[50] The following discussion explains blockchain's key attributes, highlights its core innovations and benefits—as well as limitations—and describes some blockchain applications that are under development.

A. The Key Attributes

Blockchain's core feature is that it provides unrelated parties with assurance that a given transaction on a network is legitimate and not duplicative.[51] With this technology, transactions can be validated without dependence on a trusted third party.[52] Blockchain technology also ensures that the database on which transactions are stored is secure and cannot be modified.[53] To provide this level of trust, the technology uses a distributed electronic ledger, a consensus mechanism, and cryptographic security.[54]

A distributed ledger means that the database of transactions is not stored in a single location, but rather is replicated and stored across multiple computers or nodes.[55] This network may be comprised of different parties, sites, or institutions.[56] Each time the database is updated, all of the ledgers across the network are automatically synchronized.[57] As a result, each participant maintains an identical and complete copy of the database at all times, which means that there is no single point of failure.[58]

However, not all distributed ledgers use blockchains.[59] A distributed ledger that implements blockchain technology is different from other

50. *See* MELINA K. MUTAMBAIE, BLOCKCHAIN TECHNOLOGY – THE NEXT COMPUTING PARADIGM SHIFT 3 (2018), https://bit.ly/38eNV7u.

51. *See* Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 DUKE L.J. 313, 325 (2017).

52. *See* CARSON ET AL., *supra* note 46, at 4.

53. Blockchain technology allows transactions to be added to the database, but it does not allow previously stored transactions to be altered except in exceptional circumstances. *See* James Ovenden, *Why Blockchain Hype Must End*, INNOVATION ENTER. (Mar. 28, 2019), https://bit.ly/37zGPKb; HANCOCK & VAIZEY, *supra* note 46, at 17–18.

54. *See* Werbach & Cornell, *supra* note 51, at 326.

55. *See* HANCOCK & VAIZEY, *supra* note 46, at 5, 18; BAISALBAYEVA ET AL., *supra* note 46, at 12.

56. *See* HANCOCK & VAIZEY, *supra* note 46, at 5, 18.

57. Generally, each ledger or node repeats the calculation of the consensus mechanism to ensure the new block is valid. *See id.* at 21–22.

58. *See* Werbach & Cornell, *supra* note 51, at 325; EMILY RUTLAND, R3 RESEARCH, BLOCKCHAIN BYTE 3 (2017), https://bit.ly/3FESEeH. However, different types of blockchain and distributed ledgers exist. Thus, depending on the design of the system, all participants may not necessarily have access to all of the information in the database. *See id.* at 6.

59. *See* BAISALBAYEVA ET AL., *supra* note 46, at 12.

distributed ledgers because blockchain technology aggregates, encrypts, and stores the record of transactions into a series of blocks.[60] Each block contains a time-stamped bundle of the transactions and a unique identifier.[61] This unique identifier, or "hash," is produced cryptographically. This means that a computer program uses a complex mathematical calculation to convert an input of data into an alphanumeric string or other format that is only readable by authorized users.[62] The information on each block is also encrypted through the use of cryptographic technology so that only authorized users may view the data.[63] Finally, each block on the blockchain also contains the hash of the prior block of validated data.[64] By linking each bundle of transactions to the previous ones, the network reconfirms the accuracy of the prior data whenever a new block is added to the blockchain.[65] This feature maintains the integrity of the entire blockchain ledger and prevents modifications to data.[66]

Before a new block of information may be created and added to the ledger, authorized network users must reach a consensus that the transaction data is valid.[67] The method used to validate the transaction and create new blocks is generally referred to as the consensus mechanism or consensus protocol. This consensus mechanism is a key feature of the blockchain and is often viewed as a major innovation.[68] To motivate actors to participate in this validation process, consensus

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Although the terms "blockchain" and "distributed ledger" are often used interchangeably, they are not identical. Blockchain is just one type of distributed ledger. Thus, all blockchains are distributed ledgers, but not all distributed ledgers use blockchains. *See* RUTLAND, *supra* note 58, at 2; BAISALBAYEVA ET AL., *supra* note 46, at 12.

60. *See* HANCOCK & VAIZEY, *supra* note 46, at 17; BAISALBAYEVA ET AL., *supra* note 46, at 12; RUTLAND, *supra* note 58, at 3.

61. *See* Bayu Adhi Tama et al., *A Critical Review of Blockchain and Its Current Applications*, 2017 INT'L CONF. ON ELEC. ENG'G & COMPUT. SCI. 109, 110 (2017).

62. *See id.* Note that this describes the blockchain used by Bitcoin, but this is not the only possible form of blockchain.

63. Steve Perry, *What is Blockchain? A Primer on Distributed Ledger Technology*, IBM: THE DEVELOPERWORKS BLOG (Mar. 19, 2018), https://bit.ly/3Cfc22m.

64. *See* RUTLAND, *supra* note 58, at 2.

65. *See* BLOCKCHAIN FOR DUMMIES, *supra* note 49, at 14.

66. The use of a hash allows blockchain technology to prevent previously stored data from being altered, because if any of the data changes, the hash or unique identifier also changes, which would immediately signal the unauthorized change. *See* Charlie Harman, *What's a Blockchain (and Why the Hype?)*, CALVIUM (Mar. 28, 2019), https://bit.ly/39MB5NT.

67. *See* BAISALBAYEVA, *supra* note 46, at 12; Richard T. Ainsworth, Musaad Alwohaibi, & Mike Cheetham, *VATCoin: Can a Crypto Tax Currency Prevent VAT Fraud?*, 84 TAX NOTES INT'L 703, 705 (2016) [hereinafter Ainsworth, Alwohaibi, & Cheetham, VATCoin].

68. *See* Werbach & Cornell, *supra* note 51, at 327.

mechanisms rely on some sort of incentive structure.[69] This process is what removes the need to use a trusted third party to validate the transaction.[70]

Various consensus mechanisms exist to corroborate the information inputted into the system. The method selected depends on the blockchain structure and the needs of the network.[71] In general, consensus mechanisms are usually based on two principles: (i) that the validators have invested resources into the network and (ii) that there is a verifiable ledger of all previous transactions.[72] Many types of consensus mechanisms exist, but they typically vary in the degree of the decentralization of the network, the amount of resources (e.g., assets, work, etc.) required to be invested in the system to gain power, and the method of incentivizing participation.[73]

Once a new block of data is authorized according to the network's consensus mechanism, the new *block* of valid transactions is then cryptographically *chained* (or linked) through a hash to the prior series of connected blocks chronologically, thereby forming a *block chain* (or an encrypted record of all confirmed transactions).[74] This updated ledger is synchronized across all the nodes in the network. Furthermore, the updated ledger can be shared and corroborated by anyone with the appropriate permissions.[75] Through this process, blockchain technology provides participants with assurance that the transaction is valid, that the data native to the blockchain is accurate, and that everyone has the same

69. For instance, some consensus mechanisms rely on economic rewards, such as the receipt of tokens or the payment of transaction fees, to incentivize network actors to participate as validators. Other consensus mechanisms, often used in private networks, may rely on legal contracts between known participants to generate trust and incentivize network validation. *See* Shermin Voshmgir, *Blockchains & Distributed Ledger Technologies*, BLOCKCHAINHUB BERLIN, https://bit.ly/3w3i3eQ (last visited Dec. 9, 2019).

70. *See id.*

71. *See* RUTLAND, *supra* note 58, at 2.

72. *See* Demelza Hays, *Consensus Mechanisms*, CRYPTO RSCH. (June 17, 2018), https://bit.ly/3sQiibt.

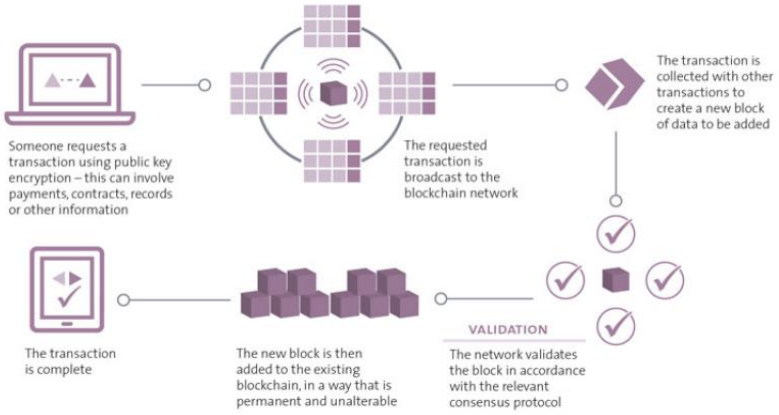
73. *See id.* For instance, decentralized networks often use a consensus mechanism that involves a complex algorithm to generate trust in the network, such as the "Proof of Work" consensus algorithm used by the Bitcoin network or the "Proof of Stake" consensus algorithm that randomly selects the validator among network actors who have certain financial stake in the network. *See id.*; HANCOCK & VAIZEY, *supra* note 46, at 17. Conversely, in situations where the network is limited to pre-selected and known participants, then trust in the network does not need to be generated by an algorithmic consensus mechanism. *Id.* The consensus mechanism used in this type of network may be a "multi-signature" consensus, which simply requires that a majority of the participants agree that a transaction is legitimate, or, alternatively, a mechanism that requires only trusted actors to validate and digitally sign the transaction. *See id.*

74. *See* BAISALBAYEVA ET AL., *supra* note 46, at 12; RUTLAND, *supra* note 58, at 3 ("While a blockchain automatically produces a new 'block' after certain predetermined criteria is met, a distributed ledger only verifies a transaction once it is submitted . . . .").

75. *See* BLOCKCHAIN FOR DUMMIES, *supra* note 49, at 16, 22.

version of the blockchain. In other words, blockchain technology takes the place of the trusted third party or intermediary.[76]

The diagram below illustrates how the blockchain process generally works:[77]



B. Types of Blockchain Systems

Blockchain technology can be designed in numerous ways to satisfy the objectives and commercial requirements of blockchain systems.[78] Several different types of blockchain systems exist.[79] Currently, the main distinction between different blockchain systems is the level of decentralization that it supports.[80]

On the one end of the spectrum are public blockchains that are "permissionless," such as the technology underlying Bitcoin.[81] A public blockchain is a decentralized system, which means that there is no overall owner or intermediary that controls the ledger or underlying infrastructure.[82] Instead, the system grants all participants the right to

76. *See id.* at 7.

77. *See* Andre Decastro, *Blockchain and IoT: A Perfect Match?*, BLOCKGEEKS (May 4, 2020), https://bit.ly/3sUhkLj.

78. *See* CARSON ET AL., *supra* note 46, at 4.

79. *See* BAISALBAYEVA ET AL., *supra* note 46, at 10–11; *Private, Public, and Consortium Blockchains – What's the Difference?*, BINANCE ACAD. (Apr. 29, 2021), https://bit.ly/3NuID6A [hereinafter *Private, Public, and Consortium Blockchains*].

80. *See* HANCOCK & VAIZEY, *supra* note 46, at 17, 35 (noting that "centralisation is just one dimension along which this domain can be analysed"); Voshmgir, *supra* note 69.

81. *See* HANCOCK & VAIZEY, *supra* note 46, at 35.

82. *See Private, Public, and Consortium Blockchains*, *supra* note 79.

view transactions and host a copy of the database.[83] When a public blockchain is also permissionless, there are no limitations on who can input information and participate in validating blocks, provided that the appropriate consensus mechanism is satisfied.[84]

On the other end of the spectrum are private blockchains. Private blockchain systems are centralized and may have one or many fixed owners or administrators that control the network.[85] Thus—contrary to common misconception—although all blockchains are distributed ledgers, they are not all decentralized.[86] Private blockchains are also "permissioned" blockchains, which means that the platform controls who is allowed to participate in the validation process, access certain information, and input information into the system.[87] In other words, in a private blockchain, the owners of the blockchain invite, authorize, and limit who may participate in the network and designate the user's rights to view, add, and validate transactions on the ledger.[88]

Finally, different models exist along this spectrum. For instance, the consortium blockchain is an increasingly popular hybrid blockchain model that contains elements of both a public and private blockchain and operates in the middle of this spectrum.[89] A consortium blockchain is a semi-decentralized blockchain structure where multiple parties—rather than either the public or a single entity—implement and maintain the blockchain platform and validate the blockchain transactions.[90] As with other permissioned blockchains, the platform owners would be able to implement restrictions that limit aspects of network participation and/or restrict access to transaction details of participants with the appropriate permissions.[91]

Each of these models can be further customized depending on the platform's specific purpose, security preferences, and user base.[92] Moreover, as the capabilities of blockchain technology continue to evolve, new types of blockchain structures are likely to emerge. This

83. *See* Voshmgir, *supra* note 69; *Private, Public, and Consortium Blockchains*, *supra* note 79; RUTLAND, *supra* note 58, at 2.

84. *See* CARSON ET AL., *supra* note 46, at 5.

85. *See id.*

86. *See* HANCOCK & VAIZEY, *supra* note 46, at 7.

87. *See id.*; *Private, Public, and Consortium Blockchains*, *supra* note 79; Voshmgir, *supra* note 69, at 9.

88. *See* SCHNEIDER ET AL., *supra* note 5, at 10; BAISALBAYEVA ET AL., *supra* note 46, at 11. For instance, "keys" may be assigned specific rights in a network that enable users with that key to participate in the network in some manner when certain conditions are met. *See* HANCOCK & VAIZEY, *supra* note 46, at 22.

89. *See Private, Public, and Consortium Blockchains*, *supra* note 79.

90. *See id.*

91. *See* BLOCKCHAIN FOR DUMMIES, *supra* note 49, at 15.

92. *See* LUDOVIC COURCELAS ET AL., EU BLOCKCHAIN OBSERVATORY AND FORUM 2018-2020 CONCLUSIONS AND REFLECTIONS 56 (2020), https://bit.ly/3csF6sn.

Article proposes the use of a private or hybrid blockchain model for purposes of tax administration. This model has the potential to increase cost-effectiveness, process transactions faster, minimize data privacy risks, limit participants, and contain other features that are necessary for government use of the technology.[93]

C. Challenges and Limitations

Despite blockchain's numerous benefits, this technology is not a silver bullet and has its limitations. These challenges include data security and data privacy issues, an inadequate and fragmented regulatory framework, coordination challenges, insufficient interoperability and standardization, complexity, costs, and general technical issues.

1. Data Privacy & Data Protection

One concern that blockchain often raises is how to ensure data protection and privacy. As further discussed below, blockchain technology's transparency and visibility offer significant value.[94] At the same time, these features "must be counterbalanced by adequate confidentiality, data protection and privacy measures."[95] This is especially true in the tax space where a high level of privacy and security is required to protect taxpayer data.[96] Despite offering a secure record of transactions through its use of a distributed database, consensus mechanism, and cryptographic security, blockchain technology is not immune to attack.[97] Addressing these data privacy and protection concerns are critical for the success of blockchain; security measures should be taken to minimize any vulnerabilities.

Despite the foregoing, this limitation should not hinder governments from considering the adoption of blockchain technology because these

93. *See* TOM LYONS ET AL., THE EUR. UNION BLOCKCHAIN OBSERVATORY & F., SCALABILITY, INTEROPERABILITY, AND SUSTAINABILITY OF BLOCKCHAINS 8 (2020), https://bit.ly/3PC0Dgo; RUTLAND, *supra* note 58, at 3.

94. *See infra* Part III.A.2.

95. Owens & de Jong, *supra* note 6, at 611. Another issue that jurisdictions subject to stronger privacy laws (such as the General Data Protection Regulation) must consider is how to comply with these types of data protection regulations when blockchains often contain megadata and maintain a permanent historical record of data. *See* Frank Fiorille, *The Future of Blockchain in the Payroll Industry*, HR DAILY ADVISOR (Oct. 15, 2018), https://bit.ly/3mQX5KV.

96. *See* BAISALBAYEVA ET AL., *supra* note 46, at 14.

97. *See* Owens & de Jong, *supra* note 6, at 607 (raising the question of whether data protection is inherently compromised "if the protection mechanism time-freezes when a transaction is recorded and does not automatically evolve with time"); *see also* HANCOCK & VAIZEY, *supra* note 46, at 6.

challenges are not unique to blockchain technology.[98] Data privacy and security is a major concern that extends to all technologies and is "part of the general challenge of ensuring the security of the digital infrastructure on which modern societies now depend."[99] All encrypted data and communications currently face the risk that the mechanism used to encrypt the data will be hacked.[100] Human error in the process often contributes to the majority of data security and privacy breaches involving all technologies, not just blockchain technology.[101] Moreover, because a platform often integrates blockchain with other software, websites, Application Programming Interfaces ("APIs"), legacy systems, and technologies that are already subject to traditional cyber-security vulnerabilities, any blockchain-based component naturally becomes subject to these vulnerabilities.[102]

Moreover, the level of data privacy provided by blockchain varies based on the type of blockchain, the consensus mechanism, and other governing policies regarding the platform. For example, a public blockchain is open to forensic analysis and raises concerns that personal identifying information can potentially be connected to the taxpayer.[103] The blockchain community is aware of this vulnerability and is making significant progress in improving data privacy on blockchains.[104] Research shows that "[n]ew data obfuscation and privacy-preserving technologies, like ring signatures, homomorphic encryption and zero-knowledge proofs, are maturing and will provide tools to greatly enhance data security."[105] Security near the "edge" of the network (or the source of the data) is also improving, which further minimizes data privacy and security vulnerabilities.[106]

Alternatively, the use of a private, permissioned blockchain structure, which restricts the number and identity of users who may interact with the blockchain and its features, is another way to minimize data privacy risks.[107] However, a private blockchain does not completely resolve all data privacy concerns and may increase certain security

98. *See* HANCOCK & VAIZEY, *supra* note 46, at 6.

99. *Id.* at 6. These issues also exist in traditional ledgers maintained by third parties, which can be manipulated by the people involved. *See* TIM SWANSON, GREAT CHAIN OF NUMBERS: A GUIDE TO SMART CONTRACTS, SMART PROPERTY AND TRUSTLESS ASSET MANAGEMENT 16 (2014).

100. *See* COURCELAS ET AL., *supra* note 92, at 68 (2020).

101. *See* GUPTA ET AL., *supra* note 28, at 183.

102. *See id.*

103. *See* COURCELAS ET AL., *supra* note 92, at 69.

104. *See id.*

105. *Id.*

106. *See* GUPTA ET AL., *supra* note 28, at 183.

107. *See* COURCELAS ET AL., *supra* note 92, at 69.

risks.[108] This is because instead of relying on the security of the technology to keep the data private – as in a public blockchain – a private blockchain relies "more on best practice[s] and the honesty of network participants."[109] Thus, a private blockchain is subject to similar data privacy concerns as those currently seen in financial institutions.

Nevertheless, blockchain technology's core features already support methods to enhance data security. This is achieved through blockchain's use of a consensus mechanism that prevents unilateral additions or changes to data, the use of a distributed ledger that is cryptographically chained together that provides an audit trail and minimizes the risk of tampering, the use of cryptographically secure public and private keys, and blockchain's other core capabilities.[110] Studies indicate that the risk of the cryptography that is used to protect and validate the data on the public blockchain ledger being compromised is relatively low and that "users can have high confidence in both the distributed ledger in which blockchain data is saved, and the various consensus mechanisms used to validate transactions . . . ."[111] Thus, despite vulnerabilities, blockchain technology remains an inherently secure platform—especially in light of the continuing progress to strengthen data privacy.[112]

2. Inconsistent Regulations & Legal Risks

A second, more pressing concern related to the use of blockchain technology is the legal issues arising from an inconsistent regulatory framework.[113] The current state of regulations give rise to potential legal risks that are likely to hinder innovation.[114] Blockchain technology and blockchain-enabled innovations raise many legal issues that range from questions related to the legal recognition of blockchain applications and the rights of blockchain-based token owners to the legal implications of smart contracts.[115] Many of these issues do not fit neatly within existing regulatory frameworks. This is primarily because of blockchain's decentralized nature, its immutability, the level of anonymity it provides

108. *See* COURCELAS ET AL., *supra* note 92, at 69.
109. *Id.*
110. *See id.*
111. *Id.* at 68.
112. *See id.*
113. *See id.* at 9; Owens & de Jong, *supra* note 6, at 612.
114. *See* LYONS ET AL., THE EUR. UNION BLOCKCHAIN OBSERVATORY & F., LEGAL AND REGULATORY FRAMEWORK OF BLOCKCHAINS AND SMART CONTRACTS 5, 10 (2019), https://bit.ly/3v1PFsD [hereinafter LYONS ET AL., BLOCKCHAINS AND SMART CONTRACTS].
115. *See id.* at 5. These concerns include jurisdictional, enforceability, liability, dispute resolution and data protection issues, among others. For a more detailed discussion of some of the regulatory challenges related to blockchain, *see generally id.*; ROBERT HERIAN, THE EUR. UNION BLOCKCHAIN OBSERVATORY & F., LEGAL RECOGNITION OF BLOCKCHAIN REGISTRIES AND SMART CONTRACTS (2018).

to participants, and the automation and creation of new business models that it supports.[116]

However, resolving these issues will be vital for blockchain's success and widespread adoption. Legal certainty is critical for acquiring the support and involvement of investors, developers, and other actors to further innovate in this area. Resolving these issues is essential for blockchain users who want to ensure their rights are protected. As further discussed below, this is an important area that governments are uniquely positioned to address.

3. Coordination Challenges and Governance Issues

A related challenge in implementing a successful blockchain application is the coordination of the many different actors involved in the blockchain platform.[117] "The issue is not identifying the network—or even getting initial buy-in—but agreeing on the governance decisions around how the system, data, and investment will be led and managed."[118]

Consider how blockchain technology's use of a consensus mechanism to corroborate transactions added to the ledger requires multiple parties to verify the accuracy of the information. The strength of the consensus mechanism and the security measures in place affect the integrity of the underlying data[119]—especially in the case of private blockchains. Thus, getting the parties to agree on an effective consensus mechanism and ensuring the strategic motivations of the participants are aligned is critical for the success of the blockchain platform; but that requires complex considerations among the participants.[120] Other governance issues revolve around who manages the blockchain protocols and how changes to protocols are made, among other questions that require agreement among various counterparties to build this common infrastructure.[121]

Many of these challenges arise in the creation of any new IT platform, but the decentralized nature of blockchain technology magnifies these coordination and governance issues.[122] The magnitude of the coordination that this requires increases exponentially when cross-

116. *See* COURCELAS ET AL., *supra* note 92, at 49.
117. *See* CARSON ET AL., *supra* note 46, at 16.
118. *Id.*
119. *See* Voshmgir, *supra* note 69.
120. *See* CARSON ET AL., *supra* note 46, at 16.
121. *See generally* TOM LYONS & LUDOVIC COURCELAS, THE EUR. UNION BLOCKCHAIN OBSERVATORY & F., GOVERNANCE OF AND WITH BLOCKCHAINS (2020), https://bit.ly/3IQrvXL (providing a detailed analysis of the numerous governance issues created by blockchain-based platforms).
122. *See id.* at 7.

border payments and global networks are involved.[123] Moreover, the lack of common standards and inadequate governance structures contribute to difficulties in coordinating the dispersed users.[124] These are important coordination issues that will need to be resolved regardless of whether blockchain is ultimately adopted, especially as our economy becomes more digitalized and global.

4. Inadequate Interoperability & Standardization

In addition, a lot of blockchain's value derives from its network effects and potential interoperability, or the ability to communicate and share data across devices.[125] The two main ways to currently achieve interoperability across blockchains are to either (i) use an external, trusted third party to validate the transaction or information[126] or (ii) use other blockchains or smart contracts) to cryptographically attest and directly exchange information between blockchains or other devices.[127] But to truly revolutionize our current systems, a blockchain platform also needs to provide interoperability across all types of disparate systems and cross-chain interoperability. Most blockchain platforms already provide interoperating methods to enable the blockchain to link to the outside world, but these need to be developed further to support a wider range of interoperability.[128]

In addition to technological limitations, insufficient standardization is another obstacle to the development of an interoperable blockchain platform. Standardization of blockchain technologies that provides a common language with specific rules for interaction is key to achieving interoperability and data exchange among different users, applications, and systems.[129] Without these features, a blockchain platform may not provide much benefit over multiple siloed databases.[130] Even though

123. *See* AINSWORTH & VIITASAARI, *supra* note 7, at 29.

124. Currently, there is a big debate regarding whether there is a need for regulation of legal issues related to governance on the blockchain or whether relying on existing contract law is sufficient. This Article does not intend to weigh in on the debate but rather seeks to highlight the governance considerations that arise in the blockchain context. For an in-depth discussion of the controversy, see *generally* Carla L. Reyes, *(Un)Corporate Crypto-Governance*, 88 FORDHAM L. REV. 1875 (2020).

125. *See* CARSON ET AL., *supra* note 46, at 11.

126. This can be accomplished by using of an off-chain third party or parties to authorize the exchanged information, or, alternatively, by relying on a digital certificate or other "outside data source to provide trusted reference information." *See* LYONS ET AL., *supra* note 93, at 11.

127. *See* LYONS ET AL., *supra* note 93, at 11.

128. *See* KAIHUA QIN & ARTHUR GERVAIS, AN OVERVIEW OF BLOCKCHAIN SCALABILITY, INTEROPERABILITY AND SUSTAINABILITY 13 (2018), https://bit.ly/3AYKCNz.

129. *See* LYONS ET AL., *supra* note 93, at 12.

130. *See* CARSON ET AL., *supra* note 46, at 11.

achieving this level of standardization both domestically and abroad is challenging, substantial resources are being invested to develop common standards.[131] It is likely that the interoperability of blockchain-based platforms will significantly improve and that a "small number of global blockchain networks will" ultimately develop as the base infrastructure upon which other blockchains, applications, and technologies operate.[132]

5. Complexity

Another major challenge to successfully adopting a blockchain application is the level of complexity involved. Before a government entity or company can begin to consider implementing a blockchain solution, it first needs to obtain an understanding of blockchain technology's complex terminology, features, and benefits.[133] Even with a baseline understanding of the technology, the complexity involved in actually creating, implementing, and transitioning to a new blockchain system is often a significant barrier.[134] Currently, there are limited commercial applications of blockchain technology.[135] Overcoming the limitations discussed above to realize the benefits of blockchain technology will be difficult.

This complexity also contributes to issues with verifying the accuracy of the data stored on the blockchain. The use of smart contracts often exacerbates these issues. In particular, issues arise concerning how to guarantee that the software code accurately captures the agreed-upon rules governing the data when smart contracts are used to automate complex processes.[136] Put differently, how would taxpayers and tax authorities verify that these smart contracts are capturing and providing accurate tax data? Fortunately, "new tools and techniques to audit smart contracts and publicize vulnerabilities and best practices are being developed," which may help address some of these issues.[137]

6. Costs

Another concern presented by the introduction of any new technology—including blockchain—is the cost involved. Blockchain technology has the potential to improve the efficiency of many processes, thereby reducing redundancies, errors, and other transactional

131. *See* LYONS ET AL., *supra* note 93, at 12.

132. *See id* at 5.

133. *See* Peter Daisyme, *Blockchain Adoption Barriers in Startups and Enterprises*, DUE (Jan. 24, 2022), https://bit.ly/3L9sIut.

134. *See id.*; DELOITTE, *Breaking Blockchain Open: Deloitte's 2018 Global Blockchain Survey* 24, 43 (2018), https://bit.ly/3DiTNcJ .

135. *See id.* at 7.

136. *See* Owens & de Jong, *supra* note 6, at 607.

137. *See* COURCELAS ET AL., *supra* note 92, at 68.

costs. Despite this, implementing and running a blockchain-based platform also requires financial investment. For instance, there are the costs for (i) the reward offered to incentivize users to participate in the network, (ii) the equipment to run the blockchain network, and (iii) financial and time expenditures required to develop the network, the smart contracts, and other blockchain-related features.[138]

These costs should be closely evaluated and not underestimated before developing a blockchain-based application to replace an older legacy system. Moreover, these costs can present a challenge for tax agencies, such as the IRS, who already face significant budget constraints and are unlikely to have the resources to replace their legacy systems. However, these costs vary significantly across blockchain applications and are expected to decline over time as the technology matures and becomes more widely available.[139]

7. General Technology-Related Issues

Finally, as a new technology, blockchain has numerous technological limitations to overcome before it can experience widespread adoption. As noted above, advancements in capabilities and standards to improve interoperability are essential. Another prerequisite for blockchain's success is improving the scalability of blockchain platforms to allow them to rapidly handle large volumes of transactions.[140] Participants in blockchain platforms also need assurance of the sustainability of this technology over the long-term.[141] The blockchain community is continuously developing resolutions to these challenges to improve the viability of widespread adoption of blockchain technology.

In summary, blockchain technology has many limitations that need to be overcome before its true value can be realized in the tax space. Given the infancy of the technology, there are likely additional limitations and unknown barriers that will need to be addressed before blockchain can reach its true potential. Significant time and effort is being expended on overcoming these difficulties and, as this Article argues, policymakers have an important role in contributing to these efforts.[142]

138. *See* Owens & de Jong, *supra* note 6, at 608.

139. *See* GUPTA ET AL., *supra* note 28, at 182 (noting that "countries in developing regions may be at a distinct advantage when it comes to digital technology adoption owing to the relative lack of existing infrastructure").

140. *See* LYONS ET AL., *supra* note 93, at 10–11.

141. *See id.* at 12–13.

142. *See infra* Part IV.

D. Blockchain Applications

Blockchain technology has numerous applications currently in use that extend beyond possible applications in the tax realm. The most commonly known and most successful application of blockchain technology, thus far, has been for the creation of cryptocurrencies, such as Bitcoin.[143] This application of blockchain technology has allowed participants to remove financial institutions, credit card vendors, and other traditional intermediaries from the payment process. In particular, blockchain technology, with its distributed database and consensus mechanism, ensures on its own that double spending does not occur rather than necessitating that an intermediary verify that multiple parties are not spending the same cash simultaneously. As a result, blockchain facilitates electronic payment systems on a global network comprised of unrelated counterparties.[144] This application of blockchain technology has already begun to revolutionize traditional value-transferring structures and global commercial banking.[145]

Outside of the cryptocurrency space, developers have already created and are actively exploring additional applications of blockchain technology in numerous industries.[146] These applications range from using blockchain to improve the efficiency of operations in fields as diverse as financial services, healthcare, real estate, shipping, consumer goods, and manufacturing.

For instance, in the healthcare industry, a blockchain-based application has been proposed that could reliably store and enable authorized parties to securely share electronic health records. This system would work as follows: (i) an authorized user would input the medical data via a smartphone application or online portal, (ii) that information would then get stored on a private blockchain cloud, which would ensure that the data could not be altered by anybody, (iii) the patient would then be able to manage and share any portion of that data securely via the smartphone application, and (iv) any interactions with the data would be stored on the blockchain in an auditable, transparent, and secure manner.[147]

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143. *See* MUTAMBAIE, *supra* note 50, at 3 (identifying applications that employ blockchain as a payment system as the first iteration of blockchain applications or "Blockchain 1.0"); SAMI AHMED, CRYPTOCURRENCY & ROBOTS: HOW TO TAX AND PAY TAX ON THEM 6 (2017), https://bit.ly/3lZCbIU; HANCOCK & VAIZEY, *supra* note 46, at 61.

144. *See* AHMED, *supra* note 143, at 6.; AINSWORTH & VIITASAARI, *supra* note 7, at 7; Tama et al., *supra* note 61, at 109.

145. *See* AINSWORTH & VIITASAARI, *supra* note 7, at 3.

146. *See id.* at 11.

147. *See* Tama et al., *supra* note 61, at 110–11. *See generally* MEDICALCHAIN, WHITEPAPER 2.1 (2018), https://bit.ly/3wY2HYm.

Governments are also slowly exploring the potential of blockchain technology for public uses. Estonia, the most advanced government in terms of blockchain use, is already using blockchain to digitally authenticate and ensure the privacy of citizen and business-related information on their government databases. Estonia's use of blockchain technology has enabled them to launch digital services related to business filings, taxes, and other government services.[148] Some government agencies have initiated programs to create digital identity blockchains, such as birth certificates, for citizens.[149] Blockchain technology could also be used to register intellectual property and patents, issue and verify business licenses, or enable electronic voting.[150]

But what about tax administration? Tax administration is an area that involves many costly and time-consuming processes and could benefit from increased transparency and trust. The remainder of this Article considers whether blockchain technology can be used to improve our system of tax administration.

IV. BLOCKCHAIN IN THE TAX SPACE

Our current tax administration system suffers from a large tax gap, high compliance and administrative costs, a lack of transparency, and many inefficiencies. However, as the following Part argues, blockchain technology introduces promising possibilities to modernize our current tax administration system. Section A demonstrates how the core attributes of blockchain technology translate into benefits that are readily applicable to tax administration. Section B considers how these attributes can be used to improve the tax administration system and achieve long-lasting benefits.

A. Benefits for Tax Administration

Blockchain technology's most compelling benefits include the creation of trust in processes, increased transparency, potential operational efficiencies, as well as other noteworthy benefits. Each of these attributes could significantly impact a tax administration system by enabling tax authorities, the taxpayer, and other related parties to rely on a shared repository of tax-related information.

148. *See* Francois Badenhorst, *Blockchain Pegged as UK's Tax Future*, ACCOUNTINGWEB (Jan. 27, 2016), https://bit.ly/3MXxhYU.

149. *See* Bridget J. Crawford, *Blockchain Wills*, 95 IND. L. J. 735, 780 (2020).

150. *See* HANCOCK & VAIZEY, *supra* note 46, at 69.

1. Trust

Arguably the most transformative benefit of blockchain is the technology's ability to create a network of trust in transactions. In particular, the use of a consensus mechanism that relies on multiple, unrelated parties to validate transactions ensures the trustworthiness of the transactions that are incorporated into the shared database without requiring the presence of any independent intermediary or agent.[151] This is particularly valuable in situations where the data is native to the blockchain because blockchain technology cannot be used to validate the underlying data when that data is not native to the blockchain. Alternatively, blockchain technology can also create a valuable network of trust in transactions in cases where the data input to the blockchain is coming from a reliable outside source that has validated the underlying data.[152]

Blockchain's validation processes, combined with the linking mechanism that the blockchain structure uses to connect transactions in the ledger to prior transactions, further guarantees the integrity of the transactions by minimizing deliberate or involuntary record changes.[153] Moreover, blockchain's ability to use various crypto-economic incentives incorporated into the platform establishes an additional layer of trust in a decentralized system that prevents unauthorized revisions. This often provides an advantage over traditional legacy systems.[154] In short, by creating a clear and unalterable audit trail, blockchain's key features support a high-level of trust in transactions which reduces the need for trust between participants in the transactions.

Trust is especially important for effective and efficient tax administration. Both taxpayers and tax authorities need to have trust in the information and the processes that are used to compute their tax liability in order to have ultimate trust that the system is working fairly. Because blockchain provides a system of verifying transactions and maintaining their continued integrity, this technology offers a means of "creating trusted audit trails" of reliable information that can be relied

151. *See* COURCELAS ET AL., *supra* note 92, at 36.

152. *See* LYONS ET AL., *supra* note 93, at 11.

153. *See* BAISALBAYEVA ET AL., *supra* note 46, at 10; HANCOCK & VAIZEY, *supra* note 46, at 6, 22.

154. *See Blockchain vs. Distributed Ledger Technologies (DLTs): Part 1*, CONSENSYS (Apr. 5, 2018), https://bit.ly/3wYYRPO (These benefits extend beyond merely preventing forgeries, because the "[t]rust gained from this type of immutability can eventually be attached to a new value system as assets begin to undergo digitization") [hereinafter CONSENSYS]; *see also* HANCOCK & VAIZEY, *supra* note 46, at 20.

upon by all relevant parties, provided that the underlying data comes from a reliable source.[155]

2. Transparency

Blockchain technology can also provide significant benefits for tax administration by increasing the transparency of transactions. It does so by creating a clear audit trail of transactions occurring on the blockchain, thereby improving data accessibility among numerous counterparties, allowing for the traceability of a greater range of transactions and business processes, and supporting the possibility of real-time reporting.[156] This transparency improves the visibility of many transactions and can help tax authorities overcome some of the information constraints that they currently face by making it easier to exchange and share data with other government agencies, tax authorities, and third-party reporters. It is important to note that this technology will not resolve all of the IRS's current information constraints, such as those related to cash transactions and self-employment income. Blockchain technology does have the potential, however, to improve the visibility of cross-border transactions by facilitating tax authorities' ability to engage in a broader range of automatic information exchange regimes.

In particular, as a type of shared, distributed ledger, blockchain technology enables all authorized parties to view a copy of the same ledger.[157] Organizations frequently utilize different proprietary systems, which makes it difficult to share relevant information outside of the organization.[158] Blockchain technology overcomes these challenges by allowing authorized users—both within and across organizations—to directly access the same copy of the shared database. [159] This feature minimizes the need for different participants to maintain their own duplicate ledgers which are subject to redundancies and discrepancies.[160] Through the use of a blockchain platform, all authorized parties can have real-time access to the same information needed for tax filings.[161]

155. LYONS ET AL., THE EUR. UNION BLOCKCHAIN OBSERVATORY & F., BLOCKCHAIN FOR GOVERNMENT AND PUBLIC SERVICES 4 (2018), https://bit.ly/3aPGcOw [hereinafter LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES].

156. *See infra* Part III.B; *see also* HANCOCK & VAIZEY, *supra* note 46, at 22.

157. *See* AHMED, *supra* note 143, at 6; HANCOCK & VAIZEY, *supra* note 46, at 22.

158. *See id.* at 57.

159. *See* Werbach & Cornell, *supra* note 51, at 325; RUTLAND, *supra* note 58, at 3.

160. *See* SCHNEIDER ET AL., *supra* note 5, at 8–9. On the other hand, conventional databases "might depend on multiple 'siloed' databases behind firewalls that are not visible outside a single organization." *Id.* at 9.

161. *See* Matthew Baggetta, *How Blockchain Technology Can Change Project Management*, BLOCKGEEKS (Oct. 4, 2021), https://bit.ly/3lmLwum ("With blockchain technology, all transactions are stored securely on a digital ledger. This means that when it comes to paying taxes, the blockchain has an audit of exactly what needs to be paid.").

Taxpayers would benefit through immediate access to tax-related data that can allow them to fulfill their tax reporting and filing obligations with greater ease. Tax authorities would benefit through faster, more secure, and more reliable information exchanges.

In addition to increased data transparency, blockchain technology provides a means of enhancing data privacy by ensuring that only authorized parties access the data.[162] For instance, one blockchain security method is the use of public key cryptography.[163] Through this method, anyone on a public blockchain can make an encrypted transaction to the public key address, but only the party with the private key associated with that public key can decipher the transaction.[164] Private blockchains are not as secure as public blockchains because they generally use weaker consensus mechanisms. However, as with public blockchains, private blockchains do contain security measures to limit data access only to authorized participants.[165]

Moreover, blockchain technology could increase transparency because it is easier than with other technology for participants to trace which party is the source of the information. This is because records are added to the blockchain with "a unique cryptographic signature that proves the right participant has added the right record according to the right rules."[166] Through this feature, the blockchain structure further enhances the trustworthiness of the system and provides all authorized parties with access to verifiable records.

3. Operational Efficiencies

In addition, given the limited money and time of both tax authorities and taxpayers, tax administration systems need to be efficient. Thus, blockchain's potential benefit to both taxpayers and tax authorities is particularly promising because many of its core features support the creation of "efficient, inexpensive platforms, potentially leading to significant cost savings in data processing while increasing the robustness of the platforms."[167]

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162. *See* COURCELAS ET AL., *supra* note 92, at 68–69.

163. Diego Geroni, *How Does Blockchain Use Public Key Cryptography?*, 101 BLOCKCHAINS (May 5, 2021), https://bit.ly/3zlVnIr.

164. *See id.* In other words, public key cryptography generates a pair of keys, each with its own cryptographic algorithm. *See id.* The public key can be shared with other parties and is used to encrypt data. *See id.* The private key is only known by the owner. It is required to decrypt any messages that were encrypted with the associated public key. *See id.*

165. *See* COURCELAS ET AL., *supra* note 92, at 68–69.

166. HANCOCK & VAIZEY, *supra* note 46, at 22.

167. LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 4.

By improving data accessibility among parties, blockchain technology could streamline many business processes by increasing the efficiency of a network through reduced administrative burdens and transaction costs.[168] Organizations frequently maintain duplicate databases that are siloed and held by different parties, which creates administrative burdens and costs in manually maintaining and reconciling these databases.[169] A distributed database, such as blockchain, substantially reduces the need to maintain duplicate data and the need to manually reconcile conflicting data.[170] Blockchain reduces these burdens by automatically compiling validated data from various stakeholders and replicating and synchronizing that data to the ledgers of all authorized participants. Automated compiling and sharing of data can save users time and money, thus giving rise to considerable savings across organizations.[171]

Other types of distributed databases may also be able to achieve the same level of cost savings and operational efficiencies as with blockchain through enhanced database coordination and efficient data sharing among numerous parties.[172] However, blockchain may be preferable in certain cases, not only because it offers these efficiency gains, but because it also facilitates the use of other blockchain functionality that is not available in non-blockchain systems.[173]

Moreover, in cases where blockchain reduces or eliminates the involvement of an intermediary, additional cost savings may arise. Specifically, blockchain technology may reduce the cost of validating the recorded information.[174] A blockchain network that simplifies and streamlines this process can result in cost savings in cases where a third-party intermediary requires the use of labor-intensive or costly processes.[175]

At the same time, as further discussed below, the costs of migrating to and operating a blockchain system must also be taken into account, which may offset some of these cost benefits.[176] Although these costs are expected to decrease as the technology matures, it remains important to

168. *See* HANCOCK & VAIZEY, *supra* note 46, at 56–57; SCHNEIDER ET AL., *supra* note 5, at 10.

169. *See* SCHNEIDER ET AL., *supra* note 5, at 10.

170. *See id.*; HANCOCK & VAIZEY, *supra* note 46, at 56.

171. *See* SCHNEIDER ET AL., *supra* note 5, at 10; HANCOCK & VAIZEY, *supra* note 46, at 10, 56.

172. *See* HANCOCK & VAIZEY, *supra* note 46, at 56–57.

173. *See* CONSENSYS, *supra* note 154.

174. *See* Christian Catalini, *How Blockchain Technology Will Impact the Digital Economy*, U. OXFORD FAC. OF L.: OXFORD BUS. L. BLOG (Apr. 24, 2017), https://bit.ly/39C0pGy.

175. *See id.*

176. *See* Owens & de Jong, *supra* note 6, at 602.

take these costs into account when considering the overall benefits of a blockchain-based solution. Moreover, given the current state of the technology, if a public blockchain is used instead of a private or hybrid blockchain, the system may slow down and many of these potential efficiency gains may be offset.[177]

4. Other Valuable Benefits

Finally, as the technology continues to evolve, there is a high likelihood that the benefits blockchain technology provides will evolve and grow as well.[178] In fact, several of blockchain technology's most noteworthy and revolutionary features have not yet been fully developed. These developing features have the potential to provide the most significant benefits to our current system of tax administration.

In particular, one attribute of blockchain technology that has tremendous potential to improve the trustworthiness, transparency, and efficiency of tax administration is the ability to allow for the future tokenization of assets, value, and nearly any other component of our digital economy.[179] In the blockchain space, tokenization generally refers to the process of converting the rights to an asset into a digital representation of that asset.[180] In theory, using a blockchain

177. A public blockchain often uses a "computationally expensive" consensus mechanism, such as a proof-of-work consensus mechanism, to validate transactions. LYONS ET AL., *supra* note 93, at 10. Although this type of consensus mechanism effectively secures the network, it slows down the rate at which the blockchain can process transactions. *See id.*

178. Thus, the discussion in this section is not an exhaustive list of the potential benefits that blockchain may provide in the future.

179. Tokenization is a highly debated topic in the blockchain technology. *See, e.g.*, Diego Geroni, *Tokenization vs Encryption – Key Differences*, 101 BLOCKCHAINS (Aug. 23, 2021), https://bit.ly/3yXPQXh; *Why is the Real World Assets Tokenization Necessary*, PROD. PROTOCOL (June 5, 2019), https://bit.ly/3zm27WR; Ali Sunyaev et al., *Token Economy*, 63 BUS. INF. SYST. ENG. 457 (2021), https://bit.ly/3Pv0CLO. This Article does not weigh in on the debate, but instead uses tokenization as an example of the potential additional benefits that the blockchain technology provides once the regulatory and legal uncertainty and other challenges related to tokenization rights are overcome. These challenges must first be overcome before tokenization's full potential may be realized. *See* DARKO STEFANOSKI ET AL., EY, TOKENIZATION OF ASSETS 3–5 (2020), https://go.ey.com/3B4QIfj.

180. *See* Patrick Laurent et al., *The Tokenization of Assets is Disrupting the Financial Industry. Are You Ready?*, INSIDE MAG., Oct. 2018, at 62–63, https://bit.ly/3v5BFON.

Note that tokenization is not unique to blockchain and already occurs in non-blockchain contexts. For instance, traditional forms of tokenization include the securitization or data security mechanisms embedded in financial transactions. However, tokenization in the blockchain space differs from traditional forms of tokenization because this process occurs on a blockchain and allows for the digital representation of a much broader range of assets. *See* Stephen O'Neal, *Tokenization, Explained*, COINTELEGRAPH (June 2, 2019), https://bit.ly/3FZlBCq. Technically, this tokenization process involves the use of an

infrastructure, such as the Ethereum protocol, as the underlying protocol allows the digitization of almost any physical or non-physical item of value to be created and become broadly accessible.[181] This, in turn, allows the asset to be digitally transferred, owned,[182] and stored through the use of smart contracts. The use of smart contracts further replaces or minimizes the use of intermediaries and reduces administrative costs.[183] It also immutably stores the record of ownership and the history of transfers on the blockchain, which promotes additional transparency and traceability of ownership.[184]

This tokenization potential is another feature that makes blockchain technology preferable to current legacy systems. Current legacy systems often have limited capabilities in digitalizing a broad range of assets, lack interoperability with other systems, result in "'vendor lock in,'" and generally require a centrally managed platform.[185] In addition, unlike traditional means of digitalizing assets, blockchain-based tokens are generally programmed as smart contracts, which offers additional capabilities and benefits that would otherwise be difficult to achieve.[186]

Numerous types of tokens already exist.[187] Currency tokens are one example of tokenization that could be especially beneficial for tax administration purposes.[188] These tokens generally facilitate more

algorithm implemented as a smart contract on the blockchain that would define all of the features of the digital asset. *See id.*

181. *See* CONSENSYS, *supra* note 154. "Similar to how every company was able to create a website in the late 90's using HTML for the scaffolding of the web page, every company will be able to create digital economies for their services and products using Ethereum smart contracts that can create tokens which will be accessible by a broader network." *Id.*

182. This is currently the subject of debate. The token will only be considered owned if the underlying property and commercial law recognizes the token as a representation of ownership. *See* Katherine Roe et al., *Non-fungible Tokens: What Are the Legal Risks?*, DLA Piper (Oct. 18, 2021), https://bit.ly/3RReIbA; Irene Sun, *Legal Uncertainties Surrounding the Realm of NFTs*, MICH. TECH. L. REV. (2021), https://bit.ly/3PGViV1.

183. *See* STEFANOSKI ET AL., *supra* note 179, at 8.

184. *See id.* at 9. This process differs from traditional forms of tokenization, such as securitization or data security mechanisms embedded in financial transactions, because this process occurs on a blockchain and allows for the digital representation of a much broader range of assets. *See* O'Neal, *supra* note 180.

185. *See* CONSENSYS, *supra* note 154.

186. *See* COURCELAS ET AL., *supra* note 92, at 59.

187. Three common types of tokens are currency tokens, utility tokens and security tokens. Currency tokens represent a fiat or digital currency in digital form and are used as a means of payment. *See* O'Neal, *supra* note 180. Utility tokens refer digital tokens that provide the holder with rights to a future product or service and is often used as a means to raise funds for a startup. *See id.* Security tokens generally refer to a digital representation of an external, tradeable asset and represent an investment in that asset. *See id.*

188. A crypto coin or digital coin is similar to a currency token in that both run on a blockchain and serve as a medium of exchange. These two terms will be used

efficient and transparent payments between parties. More than that, if the currency token or coin that is used for payments is one that has been created by the government, then the use of blockchain-based digital currencies has the potential to enhance the visibility of transactions by providing tax authorities with high-quality transactional data in real time and, therefore, a more reliable audit trail.[189] With this information, tax authorities can better target tax evasion and non-compliance, which would help minimize the tax gap. By providing taxpayers with access to this same information, measures can also be developed to minimize a taxpayer's overall tax compliance burden. Even more significantly, tokenized fiat currencies can allow governments to eventually achieve real-time automation of payments through smart contracts.[190]

Another critical component of blockchain technology which is currently being developed and has important implications for tax administration is the technology's interoperability potential. There are numerous companies working to build secondary layers on top of blockchain protocols to make them interoperable.[191] This is a distinct advantage over many current legacy systems, which have closed networks and limited ability to communicate with, exchange data with, and use the exchanged information that comes from different information technology systems and software applications.[192] Even the use of an API, which improves the interoperability of applications by enabling two software applications to communicate with each other, does not provide the same level of interoperability that a blockchain infrastructure has the potential to achieve.[193]

With so many complex systems being networked together and all facets of our economy becoming increasingly digitalized, the ability to seamlessly interact with and exchange information among different technologies and applications is essential in our modern economy. [194] If a

interchangeably in this Article. Technically, however, a crypto coin differs from a currency token, because a crypto coin, such as the cryptocurrency Bitcoin, exists on its own blockchain and make the blockchain function, whereas currency tokens are created on an existing blockchain platform, such as Ethereum, and are used to interact with applications created through different blockchain. *See* Laura M., *Token vs Coin: What's the Difference*, BITDEGREE (Oct. 5, 2021), https://bit.ly/3ww15WW.

189. *See* GUPTA ET AL., *supra* note 28, at 319. This assumes that the government does not program updates that can wipe out the historical transaction data. *See id.*

190. *See* LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 23.

191. For instance, Metronome is a smart contract protocol layer that is protocol agnostic, so that it can run on any blockchain protocol. *See* Daniel Kuhn, *Metronome Now Lets Users Move Tokens Between Blockchains*, COINDESK (July 1, 2019, 6:30 AM), https://bit.ly/3wGcHW7.

192. *See* CONSENSYS, *supra* note 154; Brian Platz, *Beyond APIs: Blockchain Interoperability*, FORBES (Sept. 29, 2020, 7:10 AM), https://bit.ly/3cwc0Iz.

193. *See* Platz, *supra* note 192.

194. *See* LYONS ET AL., *supra* note 93, at 9; Platz, supra note 192.

blockchain technology emerges that can serve as the foundational infrastructure through which various information technology systems can operate or communicate, then that technology could provide a high level of interaction among both disparate systems and off-chain databases that do not currently exist.

This level of interoperability can provide immense benefits to our tax administration system by further improving the transparency and efficiency of tax administration. Blockchain technology could provide tax authorities and taxpayers with a more transparent and efficient platform for automated data sharing if the technology had the ability to seamlessly interoperate among ecosystems of businesses, individuals, and other governments using different platforms. The ability to share verified tax-related data on an automated basis with numerous authorized parties would improve the visibility of transactions. It would also allow tax authorities to efficiently acquire meaningful tax data, which could be used to improve compliance and enforcement efforts and may enable the automation of some taxpayer compliance functions. Both of these benefits could help minimize the tax gap.

The blockchain structure also has the potential to "be modified to incorporate rules, smart contracts, digital signatures, Internet of Things systems, and an array of other new tools," which will further "enhance and diversify the value and range of uses of ledgers."[195] "[A]s a protocol technology, computer programs can be built on top of, or incorporated into, blockchain technology."[196] For instance, blockchain can support the use of smart contracts, which is a promising application.[197] Essentially, a smart contract automates performance. It is computer code that is stored on a blockchain and sets forth the terms of an agreement, which it automatically executes and enforces once pre-determined criteria are satisfied.[198] Instead of relying on the use of a human intermediary, it primarily uses the blockchain network to add, verify, execute, and enforce the encrypted contract terms.[199] As a result of these features, smart contracts, as well as other blockchain-based innovations, further enhance blockchain's automation potential and contribute to its

195. HANCOCK & VAIZEY, *supra* note 46, at 6, 10.

196. Reyes, *supra* note 47, at 1541.

197. *See id*. at 1540. Smart contracts are not new, but blockchain technology helps enable the use of smart contracts. *See* Werbach & Cornell, *supra* note 51, at 320, 330–34.

198. *See* SWANSON, *supra* note 99, at 11, 15. Note that in order for the smart contract to execute the agreement, the trigger that certifies the predetermined condition has been met must first be input into the system. This can occur internally through other smart contracts occurring on the blockchain or through an outside source. *See* Reyes, *supra* note 47, at 1542.

199. *See* SWANSON, *supra* note 99, at 15; HANCOCK & VAIZEY, *supra* note 46, at 18; Jeremy M. Sklaroff, Comment, *Smart Contracts and the Cost of Inflexibility*, 166 U. PA. L. REV. 263, 273 (2017).

likelihood of substantially improving the trustworthiness, transparency, and efficiency of the tax administration system.

B. Transforming the System of Tax Administration

With blockchain technology's core attributes supporting the creation of greater levels of trust, transparency, and efficiency in data management and processing, an appropriate use of this technology promises improvements to our tax administration system. In particular, through the use of a private or permissioned blockchain platform, the technology can help revolutionize our current tax administration by: (i) improving digitalization of certain tax processes, (ii) increasing the transparency and trustworthiness of tax-related transactions through a shared database and other blockchain-enabled features, and (iii) reducing costs, minimizing data redundancies, and automating various elements of our tax administration system to improve the efficiency of tax administration. The following discussion suggests some novel uses of blockchain technology in the tax space that would help achieve these goals.

1. A Blockchain-Based Platform for Information Returns

One potential application for blockchain in the tax space is to implement a blockchain-based platform to aggregate, store, and securely share required information returns. Under the existing system, information reports play a significant part in reducing the information constraints faced by tax authorities. These systems could be further optimized by using blockchain technology that allows multiple counterparties to rely on a shared repository of information.

Currently, designated payers, financial institutions, and brokers submit information returns related to certain taxpayer transactions to the government and separately send these same reports to the appropriate taxpayer on an annual or other fixed basis.[200] In recent years, the efficiency of this system improved as companies began to provide more information reports electronically and the IRS increasingly implemented a system to store information reports on an electronic database.[201]

200. *See supra* notes 20–21 and accompanying text.

201. *See* I.R.S., PUBLICATION 1220: SPECIFICATIONS FOR ELECTRONIC FILING OF FORMS 1097, 1098, 1099, 3921, 3922, 5498, AND W-2G FOR TAX YEAR 2021 14–15 (2022), https://bit.ly/3N9wqEi (describing the filing requirements for certain information returns under the Filing Information Returns Electronically (FIRE) system). Filers who have 250 or more returns generally must submit the information report to the government electronically, while other filers are encouraged but not required to do so. *See id.* at 3. The threshold to file electronically is currently 250 but will be reduced to 100, with further lower limits in future years, once regulations are issued. *See* Taxpayer First Act,

Nevertheless, because taxpayers do not have access to this IRS database, they continue to unnecessarily incur time and monetary expenses in separately managing, storing, and accurately inputting tax data onto their tax return each year. Thus, a blockchain platform that acquires these information reports from existing third-party intermediaries and then stores and provides immediate access to the reports to appropriate parties could make advancements in this area. A blockchain-based solution could (i) improve efficiencies related to information reporting, (ii) help taxpayers with their tax compliance burden, (iii) enhance data transparency, and (iv) protect sensitive taxpayer data.

In particular, by enabling taxpayers to immediately and securely access their aggregated tax data in one centralized location on a private or permissioned blockchain platform, a blockchain-based database would give taxpayers better control of and more transparency with respect to their tax records. Taxpayers could then either download this tax data directly onto their tax returns or, using additional technological tools, have the tax data automatically pre-populate their tax return. Both options would simplify the tax return preparation process and minimize errors.

This proposed use of technology would also benefit third-party information issuers by eliminating their need to remit separate information statements to individual recipients, thereby saving them time and costs. The government would also likely realize administrative benefits and cost savings from the reduction in errors due to taxpayers inadvertently omitting or inaccurately reporting the tax data from their information reports, as well as from an increased ability to share relevant and trustworthy data across government agencies that require access to the same information.[202] Moreover, with the appropriate statutory changes, this system has the potential to provide parties with access to this data in real time, rather than on an annual or other fixed basis, which would improve the effectiveness of the tax authority's tax enforcement and compliance measures, and provide taxpayers with a more accurate, ongoing picture of their tax obligations.

Although blockchain is not necessarily required to achieve these goals, a blockchain-based database for the collection and exchange of tax-related data would provide several additional and valuable benefits as compared to traditional technological solutions.[203]

Pub. L. No. 116-25, § 2301, 133 Stat. 981, 1012–13 (2019); I.R.S., 2022 GENERAL INSTRUCTIONS FOR CERTAIN INFORMATION RETURNS 1 (2022), https://bit.ly/3wjQuOE.

202. *See* Jay A. Soled, *Call for the Gradual Phase-Out of All Paper Tax Information Statements*, 10 FLA. TAX REV. 345, 367 (2010); LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 18.

203. Existing legacy systems could be adapted to achieve these goals. For instance, Professor Soled proposes the use of a centralized, digital database that would store data

First, with a distributed ledger system, such as blockchain, any point of failure issues are minimized. Point of failure issues are minimized because the verified transaction is stored across a network. Of course, other technology is also available to address this concern,[204] but many current legacy systems—especially those maintained by the IRS—are at high risk in this regard.[205] Use of blockchain technology could help address these risks, while avoiding the unnecessary expense of costly backups and recovery systems.[206]

Second, blockchain technology's features enable a system design that makes the data both private and shareable, [207] which is especially important when dealing with sensitive taxpayer data. · For instance, through the use of permissions and cryptography, a blockchain network can be designed to limit participants' access to data, prevent unauthorized access, and provide different viewing rights to different parties.[208] Thus, taxpayers could potentially identify the tax-related transactional details they want to share with a particular user and provide certain tax authorities special permissions to view a greater range of transactional detail.[209] Smart contracts could also be used to enable automatic sharing of certain details when pre-determined criteria are met.[210] Moreover, as a type of distributed ledger, blockchain technology securely shares relevant data in a manner that allows authorized parties to have immediate, real-time access to the same data.[211] As compared to traditional databases, "[w]here blockchains shine is in enabling such capabilities among large, diverse groups without relying on or having to trust a single authority to do the job."[212]

Third, as blockchain technology increases its level of interoperability, tax authorities utilizing this platform can share information across government agencies and other relevant parties more efficiently without requiring all parties to upgrade their technology to access the information. As a result, government agencies could

collected from information reporting and would allow taxpayers direct electronic access to their aggregated tax data through a secure IRS website. *See* Soled, *supra* note 202, at 348. As another example, Mexico is involved in an initiative that implements open data portals, which provides access to government data online. *See* GUPTA ET AL., *supra* note 28, at 282 n.7.

204. For instance, Box, OneDrive and AWS are existing technologies that mitigate point of failure issues without the use of blockchain technology.

205. *See* Soled, *supra* note 202, at 368–69.

206. *See* LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 18.

207. *See id.* at 10; *see also infra* Section III.A.

208. *See infra* Section III.A.2.

209. *See* Blockchain for Dummies, *supra* note 49, at 16.

210. *See* HANCOCK & VAIZEY, *supra* note 46, at 24.

211. *See infra* Section II.A.

212. *See* LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 10.

streamline how they communicate with each other and reduce costs in government operations, including tax administration. Blockchain technology also presents a potentially cost-effective means of updating large legacy IT systems because different agencies could share the costs of implementing and maintaining the system. Furthermore, it would eliminate some of the additional costs associated with managing existing networking and messaging systems and the duplicative efforts in reconciling the data.[213]

Fourth, blockchain technology's automation potential provides a significant benefit over other systems. The use of smart contracts and other blockchain-based features allow tax authorities to automatically pre-populate tax returns. This feature would eliminate taxpayers' need to correctly input the data from information reports onto a tax return. Without the burdens to ensure that all the information that the IRS has received is included in their tax return, the costs and time required for taxpayers to prepare tax returns would be reduced. Blockchain technology can also automate the exchange of information from current intermediaries to the tax authority, which could further facilitate the tax authority's real-time access to this data.

Finally—and most significantly—blockchain technology enables counterparties who do not know each other to reach an agreement about the existence and evolution of shared facts between them.[214] Thus, as long as the data that enters the blockchain database is reliable data, such as third-party information returns, the use of blockchain technology ensures that the data remains in its verified form so that it is not altered by any party yet remains simultaneously accessible by all authorized parties.

2. A Blockchain-Based Platform for Digital Invoices

The shared blockchain-based database of information returns described above is only the starting point for harnessing blockchain's potential in the tax space. To achieve more transformational benefits, blockchain technology could be used to complement our existing tax system by creating a single, transparent database that collects, aggregates, stores, and securely shares a wider range of data. Specifically, a blockchain-based system could be developed to collect many types of transactional data at the source through the use of digital invoices.[215]

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213. *See* LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 18.

214. *See* Reyes, *supra* note 47, at 1526–27; Richard Gendal Brown, *Introducing R3 Corda™: A Distributed Ledger Designed for Financial Services*, THOUGHTS ON THE FUTURE OF FIN. (Apr. 5, 2016), https://bit.ly/39THQ0q.

215. *See infra* Section III.B.2.

A promising example of this application would be to use a private or permissioned blockchain to aggregate, maintain, and share data related to the computation of a company's VAT obligations.[216] Under the current VAT system, "[tax authorities are] highly reliant on businesses themselves to correctly calculate the amount of VAT due and submit it to the tax authorities."[217] This information is generally reported on an aggregate basis on a tax return that is filed on a periodic basis. Because of these features, the VAT system creates information asymmetries and visibility issues, which makes it difficult for tax authorities to detect fraud and ensure compliance. The time lag between when a transaction occurs and when the related information is submitted to the government further complicates the tax authorities' enforcement efforts. Thus, a system that could capture invoice data at its origin and implement verification processes at the source of data input would minimize a company's potential to manipulate data. It would also provide tax authorities with transaction-level data, thereby increasing the amount of data accessible to tax authorities. Furthermore, the system would increase the data's transparency and accuracy as well as the tax authorities' ability to utilize cognitive computing to effectively analyze the data for tax assessment and compliance purposes.

Due to these benefits, a growing number of countries have begun to require the use of digital invoices that submit this type of VAT-related information in a standardized format to the appropriate tax authority on a regular basis.[218] To acquire this transactional data, tax authorities use various measures ranging from requiring companies to transfer invoice data through an online portal[219] to using an Electronic Billing Machine that collects and automatically transmits transaction data to the tax authorities on a real-time basis.[220] In the United Kingdom, the "Making

216. For a more detailed discussion of the proposed use of blockchain for VAT purposes, *see generally* AINSWORTH & VIITASAARI, *supra* note 7; Ainsworth, Alwohaibi, & Cheetham, VATCoin, *supra* note 67.

217. Jurgen G., *Introducing Blockchain Technology to the World of Tax*, MEDIUM (Dec. 11, 2018), https://bit.ly/3z5QHH8.

218. *See* Azam & Mazur, *supra* note 40, at 552–54.

219. *See, e.g.*, MARTA ANDRADE PÓVOA, IOTA PAPERS, COLLABORATION WITH TAX SERVICE PROVIDERS IN THE E-INVOICE SYSTEM 3 (Jan. 2018), https://bit.ly/3t2Eb7e (describing Portugal's certified invoice software that enables companies to transfer invoice data to the Portuguese tax authorities online on a monthly basis in a standardized format); AGENCIA TRIBUTARIA, THE IMMEDIATE SUPPLY OF INFORMATION SYSTEM (S.I.I.) 6 (n.d.), https://bit.ly/3og3tMD (describing Spain's electronic invoicing system which allows taxpayers to electronically submit billing records stored on an online platform through the use of web services based on exchanging XML messages or by filling out a web form).

220. *See, e.g.*, Eva Ghirmai et al., *The Incidence and Impact of Electronic Billing Machines for VAT in Rwanda*, INT'L GROWTH CTR. (Apr. 15, 2016), https://bit.ly/3LQsDL2 (describing Rwanda's system of sharing invoice-level data with

Tax Digital" initiative captures data on a regular basis by requiring certain taxpayers to keep and store digital records of their VAT transactions using a certified software program that can exchange data with the tax authority using an API platform.[221] In general, these methods provide tax authorities with detailed data in a standardized format on a regular basis that is more readily available for auditing. As a result, these methods have, overall, experienced great success in enhancing the United Kingdom's enforcement and fraud-prevention efforts and often minimize the supplier's tax compliance burden.[222]

Using blockchain technology to capture, store, and share digital invoice data can provide additional benefits. For instance, placing invoices on a blockchain makes it easier to verify the information and prevent unauthorized tampering once the data is stored on the blockchain ledger.[223] Therefore, unlike the United Kingdom's approach, blockchain technology can authenticate the original invoice data and minimize the risk of falsification of invoice-level data.[224] Moreover, using blockchain to consolidate and store the data—rather than transferring the data through an API or an online website to a government's platform—further facilitates the real-time and electronic reporting of transaction-level tax data. This method provides companies, taxpayers, and tax authorities with access to the data as soon as it is captured. Furthermore, it allows the data collection process to be more easily automated through the use of smart contracts and other blockchain-enabled features.

From a government perspective, the immediate access to large volumes of verified information on a timely basis is advantageous because it provides tax authorities with a reliable audit trail that can be effectively analyzed to identify potential high-risk situations and better detect tax avoidance and evasion.[225] Using blockchain can also help governments reduce costs in the long-run by providing a cost-effective way to authenticate transactional information upfront, which would minimize the cost of later having to audit the transactional information.

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the tax authorities); GUPTA ET AL., *supra* note 28, at 4 (describing Russia's online cash registers that record invoice-level data and transfers it immediately to servers that tax authorities can access).

221. *See VAT Notice 700/22: Making Tax Digital for VAT*, GOV.UK (Apr. 1, 2022), https://bit.ly/3NH4OGR.

222. *See* Azam & Mazur, *supra* note 40, at 554–55.

223. However, placing the whole invoice on the blockchain could be computationally intensive and slow the network down. To mitigate this risk, the hash of the invoice could be placed on the blockchain. This concern also further supports the use of a private or permissioned blockchain to a public blockchain in the tax space.

224. *See* Ainsworth, Alwohaibi, & Cheetham, A High-Tech Proposal, *supra* note 7, at 523.

225. *See* GUPTA ET AL., *supra* note 28, at 177.

Replacing costly centralized ledgers with more efficient, distributed blockchain platforms could also generate additional cost savings.[226]

Automating this exchange of information and providing taxpayers with standardized tax-related data is also likely to benefit taxpayers. With this type of system, taxpayers are likely to spend less time and money in complying with their VAT obligations. Taxpayers are also likely to see a reduction in tax audits and disputes and experience improvements in their internal record-keeping.[227]

In addition to simplifying data collection and improving the reliability of the collected data, the use of blockchain technology also has the added benefit of facilitating the sharing of relevant and trustworthy information across a large system of counterparties. Because blockchain technology is intended to be an interoperable system that uses a common language, this technology increases tax authorities' ability to efficiently share reliable data among other government agencies, both domestically and abroad, on an ongoing basis. This is especially important as digital, global transactions increasingly challenge the current regimes of VAT collection by increasing the tax administration's current information constraints. Moreover, tax authorities can protect taxpayer privacy by designing the blockchain system to limit the information that participants can access while also ensuring that tax authorities and taxpayers have real-time access to the verified information. Thus, governments can further improve data collection, data exchange, and cooperation between jurisdictions through blockchain technology.

VAT is often the starting point for proposals to use blockchain in the tax space given its highly transactional nature and the information constraints experienced by tax authorities in ensuring compliance with the VAT system.[228] However, these measures to improve the VAT system can be expanded to other areas of the tax law. In particular, the U.S. sales tax system suffers from many similar issues and would likely experience similar transparency, accuracy, and efficiency gains as a blockchain-based VAT system does. Moreover, migrating payroll data, transfer pricing data, and domestic and international withholding tax-related information onto a blockchain platform that automatically collects the information from the source on a real-time basis is also likely to transform our current tax administration system.

Of course, these measures involve sensitive taxpayer data, so access should be restricted. Blockchain technology provides numerous methods to maintain data privacy and limit unauthorized access. For instance, to

226. *See id.* at 175; Ainsworth, Alwohaibi, & Cheetham, A High-Tech Proposal, *supra* note 7, at 528.

227. *See* Jurgen, *supra* note 217.

228. *See* FLYNN ET AL., *supra* note 12, at 3.

limit the government's access to this information (which would be cryptographically stored on the blockchain), the platform could be designed to anonymize certain data, to restrict data access unless certain conditions are met, or to provide taxpayers with the rights to completely control the access to the information.

In summary, if blockchain technology continues to mature and evolve as expected, then it has the potential make revolutionary improvements to key aspects of our current tax administration system. Nevertheless, as further discussed below, blockchain technology faces significant obstacles before it can be used in the manner described above.

V. RECOMMENDATIONS FOR MAXIMIZING BLOCKCHAIN'S BENEFIT

Even though the blockchain phenomenon is well under way, the blockchain community and policymakers need to solve an array of challenges before blockchain's transformational benefits can be realized in the tax space. This Article strongly encourages governments to be involved in the development of blockchain and other promising technologies. It is important for governments to be proactive in this process for two main reasons.

First, if blockchain ultimately lives up to its potential and the government has participated in blockchain's development, then tax authorities will likely benefit through substantial improvements in their information position, the ability to automate many tax processes, and an overall increase in the effectiveness and efficiency of the current system of tax administration. This approach also allows policymakers to ensure that the technology develops in a responsible manner.[229] Thus, by remaining involved, governments, particularly tax authorities, obtain a valuable opportunity to study and understand which technological developments can have the most positive impact on tax administration, which puts them in the best position to realize the benefits of these technologies.[230]

Second, if blockchain becomes widely adopted, but the government does not remain adequately involved with the new technology, then the information constraints under which the government currently operates will likely be magnified. Information constraints would be amplified because more revenue streams will become embedded in technology that is inaccessible to the government.[231] That situation is likely to exacerbate the current tax gap.

229. *See* OECD, *supra* note 34, at 196–97.
230. *See id.* at 194.
231. *See id.* at 201.

However, even if blockchain technology does not become a mainstream technology, exploring the use of blockchain technology in the tax space remains a worthwhile endeavor. Doing so provides government agencies and policymakers with an opportunity to reexamine the potential role technology can play in digitalizing the tax administration system and modernizing the aging technological infrastructure that currently exists. Moreover, the recommendations that this Article sets forth below would benefit the tax administration system even if another technology is ultimately adopted.

In light of these benefits, the following discussion sets forth several normative suggestions to policymakers for their support in the development of blockchain technology. These actions will help ensure that the government is prepared to capitalize on blockchain technology's potential if and when the time comes.

A. Support the Development of Standards

Policymakers should contribute to and encourage the development and adoption of standards (ideally international standards) related to the technology. Standardization of blockchain technologies that provides for a common language with specific rules for interaction is key to achieving interoperability and data exchange among different users, applications, and systems. In particular, international standards relating to reference architecture, taxonomy and ontology, use cases, security and privacy, identity, and smart contracts are important to achieving standardization in this area. These types of standards benefit the users of blockchain technology because the standards "can take the development of these technologies to the next step by providing internationally agreed ways of working, stimulating greater interoperability, speedier acceptance[,] and enhanced innovation in their use and application."[232] Although it is not possible to achieve complete standardization immediately, any progress towards creating specific interoperable functionalities that can later be expanded on can provide significant benefits to the users of blockchain technology.

Thus, encouraging the development of standards to improve the interoperability of the blockchain ecosystem would enable policymakers to play a positive role in the development of blockchain. Currently, numerous domestic and international organizations have begun organizing the development of international standards in the field of blockchain.[233] For instance, the World Wide Web Consortium

232. Clare Naden, *Blockchain Technology Set to Grow Further with International Standards in Pipeline*, ISO (May 24, 2017), https://bit.ly/3MXPHcd.

233. *See* Nicky Morris, *ISO Blockchain Standards Planned for 2021*, LEDGER INSIGHTS (June 7, 2018), https://bit.ly/3lPdijn; Ioannis Konstantinidis et al., *Blockchain*

("W3C")[234] and the Institute of Electrical and Electronics ("IEEE") Standards Association already have ongoing initiatives in this regard.[235] Thus, to support the standardization of blockchain technologies, governments can collaborate with these organizations, contribute findings based on empirical research, and provide other support in the process.

From a tax perspective, it is also essential for governments to work to standardize data models and processes—to the greatest extent possible—if they are to harness blockchain's potential benefits.[236] For governments to benefit from the increased availability of information, this information needs to be both high-quality data and rapidly accessible.[237] Standardization of data models enhances the quality of data and improves information sharing among multiple parties and across jurisdictions. Thus, any progress in the standardization of data will be extremely beneficial even if blockchain technology is not ultimately adopted.[238] As evidenced by the business process reengineering literature, a fundamental rethinking of current tax processes to tailor them to the modern environment is critical before governments can take advantage of blockchain (or other emerging technologies) to revolutionize our tax administration system.[239] This is no easy task.

Similarly, for a blockchain platform to be transformational in the tax space, governments must also engage in serious efforts to cooperate with many different actors, including other tax authorities, both to implement blockchain application and to standardize tax compliance guidelines more generally. For instance, a successful blockchain-based tax application would require federal, state, and local tax authorities and relevant agencies in many different jurisdictions to (i) participate in the network, (ii) accept that the tax payment calculations are valid, and (iii) agree on important blockchain governance decisions.[240] As recent international tax reform discussions demonstrate, achieving an international consensus on tax matters is no easy task. Nevertheless, these ongoing discussions underscore the need for this type of international cooperation. Greater coordination and common standards

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for Business Applications: A Systematic Literature Review, *in* BUSINESS INFORMATION SYSTEMS 384, 395 (Witold Abramowicz & Adrian Paschke eds., 2018).

234. *See Standards*, W3C, https://bit.ly/3wURkSc (last visited May 28, 2022).

235. For a description of activities undertaken by IEEE Standards Association related to blockchain standardization efforts, see *Standards*, IEEE BLOCKCHAIN, https://bit.ly/3wTGOe4 (last visited May 28, 2022).

236. *See* GUPTA ET AL., *supra* note 28, at 193.

237. *See id.* at 194.

238. *See id.*

239. My forthcoming article, *Rethinking Blockchain Tax Initiatives*, will explore this issue in more detail.

240. *See* CARSON ET AL., *supra* note 46, at 10.

are necessary not only to harness the benefits of blockchain but, more importantly, also to address the international tax challenges exacerbated by the digital revolution and our increasingly interconnected global system.[241]

At the very least, policymakers should aim to standardize process models. Because "while tax laws vary from nation to nation, basic processes that apply to public finance are very similar."[242] By standardizing process models, the government could benefit from further cost-savings, improved data sharing, and operational efficiencies.[243]

B. Develop a Regulatory Framework

To support the evolution and mainstream adoption of blockchain, policymakers also need to develop a clear legal and regulatory framework to help mitigate legal risks associated with use of the technology.[244] Achieving an appropriate regulatory framework is a challenging task because of the uncertainty surrounding the challenges, the implications of what the future use of blockchain applications will create, and the limited understanding that many regulators have of this technology. Successfully addressing many of these legal issues would also require a global regulatory framework, which further complicates achieving appropriate government regulations.

Nevertheless, as one commentator nicely summarizes, "[t]he law has great experience in successfully adapting to this kind of change, if often at its own pace."[245] The same is likely true for blockchain. Although it is impossible to predict in advance all of the required regulatory changes, it is important that policymakers remain proactive and involved in the process as it occurs in order to help shape regulatory policy rather than remaining purely reactive.

In addition, there are steps that policymakers can take to improve regulatory certainty in this area despite these challenges. For instance, policymakers should actively research the issues that the adoption of blockchain technology raises as it interacts with existing legacy systems

241. *See* GUPTA ET AL., *supra* note 28, at 12.

242. *See id.* at 194 (noting that such processes include "work flow, document management, authentication and certification, case management and others that are ripe for improvement").

243. *See id.*

244. *See* COURCELAS ET AL., *supra* note 92, at 38 (providing a proposed regulatory framework for Europe). Note that this proposed regulatory framework is not intended to regulate open source blockchain software development. It also does not weigh in on the debate over whether regulation of blockchain governance structures is desirable.

245. *See* LYONS ET AL., BLOCKCHAINS AND SMART CONTRACTS, *supra* note 114, at 33.

and as it creates new opportunities and business models.[246] Different regulatory approaches are available to address these various issues. Policymakers should consider targeting the issues raised by high-impact use cases first.[247] In some of these situations, it may make sense to apply existing laws and regulations; while in other cases, adapting current regulations or implementing new regulations to account for the opportunities created by blockchain may be preferable.[248] Alternatively, some cases may require a wait-and-see approach, where regulators monitor but allow a particular application of the technology to further develop and mature before issuing regulations.[249] Under the latter circumstances, self-regulation can be a beneficial approach.[250] Identifying clear guidelines on the requirements of best practices can help mitigate the risks. In developing a regulatory framework, policymakers should also strive to keep any regulatory framework "future-proof and strike a balance between freedom to innovate and addressing risks."[251]

To help achieve these goals, policymakers should collaborate with the blockchain community to identify and address the legal risks. Policymakers should also engage in blockchain experimentation with limited-use cases. By implementing limited-use cases related to government services and collaborating on blockchain projects through public/private partnerships with the blockchain community, policymakers could gain a better understanding of the technology and its issues. "Education, training[,] and hands-on experience and exposure to the technology and the ecosystem are the best ways to provide regulators the tools they need to make the best decisions."[252] Applying blockchain in limited-use cases also allows policymakers to indirectly regulate the industry by influencing how blockchain develops and is incorporated into various use applications.[253] Finally, becoming blockchain-aware puts policymakers in a position to take advantage of the opportunities blockchain provides once the technology has sufficiently matured.

Given the decentralized nature of blockchain and the tremendous potential of its cross-border applications, policymakers should also strive to collaborate with regulators abroad in the development of definitions and regulations of blockchain technology, at least to the extent

246. *See* LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 26.
247. *See* LYONS ET AL., BLOCKCHAINS AND SMART CONTRACTS, *supra* note 114, at 34.
248. *See id.* at 33.
249. *See id.* at 34.
250. *See id*.
251. *See id.* at 27.
252. *See id.* at 34.
253. *See id.* at 35.

possible.[254] Working together to identify clear guidelines and sharing best practices would allow different governments to advance research and regulation in this area to help achieve these goals.[255]

Ultimately, if blockchain sufficiently evolves and becomes integrated into tax systems, more substantial changes to the legal system will likely also be necessary to account for other implications related to this new technology.[256] The measures discussed above can help in addressing these issues as they come to the forefront.

C. Develop a Digital Invoice System

For a blockchain-based platform of tax-related data to provide tax administration systems with meaningful benefits, it is essential that quality information is acquired in an efficient and effective process. Therefore, to truly harness the benefits of blockchain in the tax space, a universal digital invoice is essential. As recognized by Ainsworth, Alwohaibi, and Cheetham, "[w]hether the goal is to blockchain an entire [tax] ecosystem . . . ; to focus on discrete market segment . . . ; or to monitor tax and financial flows associated with domestic and cross-border payments of VAT . . . , everything starts with the adoption of the digital invoice."[257] These types of digital invoices also provide significant benefits outside of the tax space, especially as society and the economy become increasingly digitalized. Thus, this Article strongly urges policymakers to work towards adopting a universal, comprehensive, mandated digital invoice.

By using an invoice that is digital and standardized, tax authorities and taxpayers can exchange data automatically with greater ease, which can minimize a taxpayer's compliance burden and improve the tax authorities' real-time access to transaction-level data.[258] Moreover, the quality of that data can be improved by embedding information into digital invoices, capturing that data instantly before any alterations occur, and imposing other measures to authenticate the origin of the data and ensure the integrity of the data can be achieved through the use of

254. *See id.* at 34.

255. *See* TOM LYONS, THE EUR. UNION BLOCKCHAIN OBSERVATORY & F., BLOCKCHAIN INNOVATION IN EUROPE 23 (2018), https://bit.ly/3zm3uET [hereinafter LYONS, BLOCKCHAIN INNOVATION IN EUROPE].

256. *See* Jurgen, *supra* note 217.

257. *See* Ainsworth, Alwohaibi, & Cheetham, A High-Tech Proposal, *supra* note 7, at 512–13.

258. *See generally*, Richard T. Ainsworth & Gordon Todorov, *Fiji: A Digital Invoice System Fights Fraud and Enforces Real-Time VAT Compliance*, TAX NOTES INT'L (Nov. 12, 2018), https://bit.ly/3xDMj0c.

universal digital invoices.[259] The use of a standardized digital invoice also enhances tax authorities' ability to proactively audit the data by requiring data to be formatted in a manner that is easily susceptible to analysis through artificial intelligence and other cognitive computing capabilities. Additionally, a universal digital invoice can assist companies by streamlining their accounting processes and reducing the time and costs involved with current invoice processes, especially as more transactions become digital.[260]

Policymakers can utilize various approaches to achieve the goal of adopting a universal digital invoice that is comprehensive and mandated. Numerous types of digital invoices already exist and there has been some movement towards universal digital invoicing in various jurisdictions and market segments, which can delineate a starting point.[261] Alternatively, creating blockchain-based invoices may be worth considering. As further discussed below, a blockchain-based invoice could provide additional benefits by making it easier to exchange and authenticate invoice data, by eliminating the historical separation between a money transfer and its corresponding documentation and bank reconciliation, and by ensuring the data is not altered once stored on the blockchain.[262]

D. Adopt a Digital Identity System

To truly harness the benefits of blockchain, policymakers should also make the development of a digital identification system a priority. Currently, the lack of a digital, reliable, single identity system presents a significant barrier for the adoption of blockchain systems for government uses, including for uses in the tax space.[263] Without an identity system that easily and securely guarantees a participant's identity, it would be challenging for blockchain—or any technology—to meaningfully improve our current system of tax administration.

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259. *See* Ainsworth, Alwohaibi, & Cheetham, A High-Tech Proposal, *supra* note 7, at 524.

260. *See Blockchain and E-billing – The Future of Invoicing?*, GOCARDLESS, https://bit.ly/38oGGtG (last visited June 23, 2022).

261. *See* Ainsworth, Alwohaibi, & Cheetham, A High-Tech Proposal, *supra* note 7, at 512. For instance, Fiji has one of the most common permutations of a legislatively mandated digital invoice. *See id.* Numerous countries have a limited-use type of digital invoice that must be transmitted automatically or on a regular basis to the government. *See id.* at 513. In some cases, governments require the use of SAF-T, "an OECD-defined standard for electronic exchange of reliable accounting data," which standardizes some of the data to a certain extent. *Id.* Additionally, some progress is being made in the United Kingdom and Saudi Arabia in moving towards a universal digital invoice. *See id.*

262. *See infra* Section IV.C.

263. *See* THIRD ET AL., *supra* note 13, at 13.

Even putting blockchain aside, a digital identity system is increasingly necessary in our rapidly growing digital economy and society. Currently, our online identities are generally established by providing key identity information on the internet to various online services in the form of login accounts and passwords.[264] This method results in one individual having numerous identities, private companies controlling identity information, and sensitive identity information becoming fragmented and stored in a multitude of databases across the internet.[265] This system is not secure, efficient, or user-friendly.[266] As a result, this information is often accessible by unauthorized parties, easily forged, and, overall, not trustworthy.[267] Efforts to advance the creation of a digital identity could provide governments and society with many long-term benefits by enabling the potential implementation of blockchain in government services, while also resolving some of the fundamental issues that exist with the current digital identity system (or lack thereof).[268]

Ideally, governments should seek to develop a single digital identity system that is interoperable across all systems and borders.[269] A complete discussion of how to design this type of system is beyond the scope of this Article. However, this area continues to gain attention and there are numerous methods policymakers can consider in establishing a digital identity system.[270]

For instance, a blockchain-based digital identity platform is a promising solution to this identity problem because it allows for a decentralized digital identification method that would securely manage and store an individual's key identity information.[271] By being stored on an interoperable and decentralized system, it allows participants to securely identify themselves using one unique identity, in contrast to the current system that requires numerous usernames and passwords to authenticate the user's identity. As a fully or even partially decentralized

264. *See* LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 20.
265. *See id.*; THIRD ET AL., *supra* note 13, at 4.
266. *See* LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 20.
267. *See id.*
268. *See id.*
269. *See* GUPTA ET AL., *supra* note 28, at 297.
270. *See* LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 21. Currently, Estonia has the most developed government use of blockchain identity services, which is deployed on the KSI Blockchain. But other governments are also working on developing digital identity services to their own citizens and interest in developing decentralized identity systems continues to grow. *See* THIRD, ET AL., *supra* note 13, at 5.
271. The system would not necessarily have to be completely decentralized. It is likely that there will remain some kind of centrally issued identification by the government. *See* LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 21.

system, it would replace the current system that requires numerous intermediaries that are not necessarily trustworthy. A blockchain-based digital identity system would also enable the creation of a "self-sovereign" identity, which means that individuals would be able to keep the verified identity information themselves and reveal proof of their identity without disclosing sensitive data.[272]

Alternatively, it is also possible to implement a non-blockchain-based digital government identity service.[273] This type of system would be centralized. As a result, the system would be unlikely to pass control over data sharing to users, but would also provide some gains in trustworthiness, transparency, and efficiency in securing sensitive data.[274] Either approach would be a substantial improvement over our current system.

Of course, developing a government-based digital identity system presents its own challenges. Challenges include developing the necessary identity standards, resolving design decisions, and addressing privacy concerns, among other issues that have yet to reveal themselves.[275] However, some work is already being done in this area;[276] with more research, development, and experimentation, many of these issues can be overcome.

E. Consider Adoption of Tokenized Currency

Policymakers should also focus their efforts on researching the development and viability of a tokenized currency for use on the blockchain platform. This could take the form of either fiat currency, a central bank digital currency or, alternatively, artificial specialized tax tokens[277] running on the same blockchain as the tax system. The use of these types of tokens has the potential to provide significant benefits to our current tax administration system.[278]

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272. *See* THIRD, ET AL., *supra* note 13, at 5.

273. For instance, France has developed a digital identification service for French citizens to access government services. *See* THIRD, ET AL., *supra* note 13, at 6.

274. *See id.*

275. *See* LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 21.

276. For instance, Wyoming is moving towards a digital identity system. Most recently, it has adopted a digital identity bill, which defines digital identity for legal purposes and lays the groundwork for future laws relating to digital identity. *See* Digital Identity Act, S.B. 39, 66th Leg., Gen. Sess. (Wyo. 2021). On a national level, a bill was recently introduced in Congress to establish a government-wide effort to assist in the development of digital identity verification. *See* Improving Digital Identity Act of 2021, H.R. 4258, 117th Cong. (2021).

277. *See, e.g.*, Ainsworth, Alwohaibi, & Cheetham, VATCoin, *supra* note 67, at 706–12 (proposing the creation of VATCoins, a crypto tax currency, to help fight VAT fraud and improve VAT compliance).

278. *See infra* Section IV.E.

In particular, a tokenized currency or artificial blockchain-based tax token could serve not only as a mode of payment and a store of value but also as a unit of account, which would inherently make payments traceable and immutable. This is important because, although blockchain technology enables users to validate transactions, the technology cannot be used to validate the underlying data when that data is not native to the blockchain.

Thus, the use of tokenized fiat currency or artificial specialized tax tokens would help ensure that transactions that enter the blockchain ledger actually occurred. The increased traceability of payments using a blockchain-based medium of exchange would increase the government's ability to track and monitor the flow of funds by making transactions more transparent and "generating more transactional data."[279] It would also provide a standardized data format that could directly and automatically integrate onto the taxpayer's online, blockchain-based ledger. Automatic integration can potentially enable taxpayers to accumulate, aggregate, store, and analyze a greater range of transactional data.

In addition, as the above discussion highlights, blockchain already has the potential to automate various aspects of our tax administration. For example, blockchain could automate exchanging information among various parties, pre-populating certain items on a tax return, and automating the acquisition of reliable data directly from digital invoices. The addition of blockchain-based tokens further facilitates these types of automation efforts. As a result, the use of blockchain-based tokens increases the possibility of revolutionizing the tax system to achieve instantaneous, automated assessment and collection of certain types of taxes.

For instance, blockchain technology combined with a digital currency or blockchain-based tokens could increase the likelihood of automating certain tax calculations and collecting taxes on a real-time basis. As one commentator notes, tokenized fiat currencies "bridge the gap between blockchains and banking systems and unfold the benefits of automatic payments powered by smart contracts."[280] These features would minimize many of the current constraints on the government's information by facilitating government access to a verified and relatively accurate data stream. This is a tremendous improvement over the current system which primarily relies on intermediaries and self-reporting taxpayers to provide government with access to tax-related data—the accuracy of which often depends on the honesty of the parties

279. *See* GUPTA ET AL., *supra* note 28, at 319.

280. LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 26.

involved.[281] Thus, by integrating revenue collection with its underlying commercial transaction, blockchain can eventually be used to automatically generate the tax-related transaction connected to the commercial transaction, assess the appropriate tax, and transfer the tax payment to the tax authority.[282]

Digital payments, in general, also provide benefits outside of the tax space. They do so by enhancing the quality of information from fiscal events, strengthening accountability by providing a more reliable audit trail, improving public financial management, and enabling more efficient and transparent payments among jurisdictions, in addition to other benefits.[283]

Given these potential benefits and the increasing use of cryptocurrencies, governments have a growing interest in issuing central bank digital currencies ("CBDC"). A CBDC is the digital form of a country's national currency that is backed by the government and is represented by a blockchain-based token. It is essentially a fiat cryptocurrency.[284] Numerous central banks are actively researching the merits of a CBDC and several have launched pilot programs to test its viability, potential uses, and limitations.[285]

Like many of the issues presented by blockchain technology, developing a digital currency, or blockchain-based tokenized currency, presents its own set of challenges, including many that are not technological in nature.[286] There are also multiple ways of developing and designing a digital currency; each method needs to be studied and explored in more detail. Unsurprisingly, the use of a CBDC is quite controversial at this time. This Article does not take a position on this issue but instead highlights that the creation and use of either a digital currency or a digital token (that is not a form of fiat currency) can provide significant benefits for tax administration purposes.

F. Implement a Public Blockchain Infrastructure

To further support blockchain's potential in the tax space, policymakers should also consider developing a public blockchain

281. *See* GUPTA ET AL., *supra* note 28, at 181.

282. *See* Jurgen, *supra* note 217.

283. *See* LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 23–24.

284. *See id.* at 23.

285. For an interactive map and description of the statuses of different countries in the development of a CBDC, see *Central Bank Digital Currency Tracker*, ATL. COUNCIL (last visited Feb. 1, 2021), https://bit.ly/3sOtLYY.

286. *See* Barbara C. Matthews & Hung Tran, *Advanced Economies Under Pressure in the Central Bank Digital Currency Race*, ATL. COUNCIL (Aug. 25, 2020), https://bit.ly/3Nwrp95.

infrastructure. A public blockchain infrastructure could serve as a base infrastructure for government services and even for digital services deployed by private actors.

"[A] new technology can't become successful on mass scale without the right infrastructure."[287] Thus, a well-designed, publicly available blockchain infrastructure can go a long way towards promoting the development of more blockchain-use cases by reducing the cost of using the underlying blockchain technology, facilitating the interoperability of systems, and supporting global communication.[288] At the same time, a public blockchain infrastructure ensures that these blockchain-based services are based on a blockchain infrastructure that complies with the applicable laws, incorporates strong privacy and security measures, and utilizes clear and responsible governance models.[289]

By supporting the development of a base blockchain infrastructure, policymakers can ensure that this system incorporates the other components necessary for a successful blockchain platform, such as a digital identity system and tokenized fiat currencies. The base blockchain infrastructure can serve as a basis and repository for digital invoices, and it can provide for a cloud infrastructure layer to help improve the scalability of future blockchain-applications.[290] Moreover, involvement in the development of a public blockchain infrastructure provides policymakers with another opportunity to better understand the technology, its benefits, and its limitations.

While developing the optimal infrastructure is challenging, governments can ease the process by benefitting from the work that other countries have already done, collaborating with private parties, or taking other steps to resolve the challenges. For instance, in Europe, progress has begun in building a European Blockchain Services Infrastructure through a collaboration of the European member states.[291] The infrastructure will initially be used to support cross-border government services, but it seeks to serve as a platform that can interoperate with commercial blockchains and provide an infrastructure for blockchain-applications by the private sector in the future.[292] As another example, Estonia currently uses a commercially-developed blockchain platform as the basis for many of its government services and has experienced

287. *See* TOM LYONS ET AL., THE EUR. UNION BLOCKCHAIN OBSERVATORY & F., SCALABILITY, INTEROPERABILITY, AND SUSTAINABILITY OF BLOCKCHAINS 17 (2020), https://bit.ly/3PC0Dgo; RUTLAND, *supra* note 58, at 3.

288. *See* COURCELAS ET AL., *supra* note 92, at 15.

289. *See* LYONS ET AL., *supra* note 93, at 17.

290. *See id.* at 17–18.

291. *See* COURCELAS ET AL., *supra* note 92, at 11, 31–32.

292. *See id.* at 27.

tremendous success in this area.[293] As progress continues to be made in the development of a base blockchain infrastructure, policymakers should support the research relating to the implementation of infrastructure-related projects.

G. Engage in Blockchain-Related Research and Education

Finally, it is also important for policymakers to continue to support the exploration and development of blockchain and other promising digital technologies through research and funding because of the technologies' potential to transform current tax processes and commercial transactions. As indicated above, many challenges remain before blockchain can reach its full potential; there is still much to be discovered regarding blockchain technology's potential role in both society and in the tax system. This is also true for other promising digital technologies. To overcome these challenges, to realize both blockchain technology and other technologies' potential benefits, and to protect citizens from any associated risks, funding for collaborative research is key.[294] Thus, policymakers should support and fund blockchain-related research and education.

In addition, policymakers should support innovation in the blockchain space by experimenting with worthwhile uses of the technology directly or indirectly by supporting public/private partnerships.[295] Doing so provides many benefits. As mentioned above, this type of investment allows policymakers to gain a better understanding of blockchain technology, its uses as well as any unintended economic or social impacts of implementing a new technology.[296] It is also worthwhile for the government to collaborate with private actors and other governments and to share research findings. Collaboration can help foster the development of the technology, facilitate the adoption of better practices, increase the likelihood of resolving these challenging issues, and improve the harmonization of approaches taken.

Blockchain technology, however, should not be a solution looking for a problem. Supporting the development of specific, concrete blockchain applications in the tax sector allows the government to study whether blockchain is the most appropriate tool to deliver worthwhile

293. *See Country Report – Blockchain: Estonia - the Land of the KSI Blockchain*, Banking Frontiers (India), 2020 WLNR 18451552 (June 30, 2020) (describing Estonia's successful use of Keyless Signature Infrastructure ("KSI") to provide government services and secure government data and systems).

294. *See* LYONS, BLOCKCHAIN INNOVATION IN EUROPE, *supra* note 255, at 19.

295. *See id.* at 5.

296. *See id.*

results or whether legacy systems (or other technologies) would provide a better solution.[297] Currently, this is difficult to effectuate given the novelty of this technology and the absence of concrete blockchain applications in the tax area that have demonstrated real results, but it is nevertheless a worthwhile endeavor. Finally, government support should also involve an investment in educating developers, entrepreneurs, government regulators and administrators, and the general public about blockchain.[298] Blockchain is a new technology that involves many technical terms and the development of complex systems. Because of this, the complexity involved in actually creating and transitioning to a new blockchain system presents a significant challenge in implementing any type of blockchain-based application. Furthermore, the complexity and novelty surrounding blockchain can also limit the design and development of potential blockchain-use cases. In short, "[c]urrent systems will be upgraded and new services created only if the people involved are given the right tools and training."[299] Thus, education, human skills development, and training are essential for overcoming many of these issues and are a prerequisite for a successful adoption of blockchain technology.

VI. CONCLUSION

If blockchain technology continues to develop and mature as expected, it has the potential to improve the tax administration system. Governments can harness blockchain's core features to make meaningful changes to the tax system, including: (i) digitalizing significant components of the tax administration system, (ii) securely recording and sharing a large quantity of verified, trustworthy, and quality tax-related data among authorized users, (iii) providing taxpayers and tax authorities with real-time access to tax records and documents, and (iv) automating certain tax processes and calculations. Together, these changes could address some of the information constraints that government agencies face, the high tax administration costs and compliance burdens experienced by both tax authorities and taxpayers, and the resource-intensive and inefficient tax administration processes currently in place.

To achieve these goals, however, many challenges must first be overcome. The blockchain community has already made significant progress in resolving many technical issues. But as this Article argues, for blockchain technology to reach its full potential in the tax space, policymakers must also take an active role in addressing the broader

297. *See id.*
298. *See* GUPTA ET AL., *supra* note 28, at 194.
299. *See* LYONS ET AL., GOVERNMENT AND PUBLIC SERVICES, *supra* note 155, at 26.

challenges that hinder the technology from making a meaningful improvement to our tax administration system.

Finally, it is important to recognize that blockchain technology is not a panacea nor is it the most suitable solution to every problem. Thus, policymakers must also consider that to truly modernize our tax system and overcome the challenges of our current tax administration, a broader revision of current processes, systems, and tax regimes is essential. Exploring the use of blockchain and other technologies in the tax space is just the first of many steps that must be taken to digitalize and fundamentally improve our system of tax administration.