LEGAL CHALLENGES AND OPPORTUNITIES OF BLOCKCHAIN TECHNOLOGY & CRYPTOCURRENCIES IN INTERNATIONAL TRADE TRANSACTIONS

Dissertation submitted to the National University of Advanced Legal Studies, Kochi in partial fulfilment of the requirements for the award of LL.M. Degree in International Trade Law

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This is to certifiy that Mr. Melvin Cherry Sam, Reg. No. LM0224013 has submitted his Dissertation titled **"Legal Challenges and Opportunities of Blockchain Technology & Cryptocurrencies in International Trade Transactions"** in partial fulfillment of the requirement for the award of Degree "Master of Laws in International Trade Law" to The National University of Advanced Legal Studies, Kochi under my guidance and supervision.

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DECLARATION

I, Melvin Cherry Sam, hereby declare that the LL.M. Dissertation titled **"Legal Challenges and Opportunities of Blockchain Technology & Cryptocurrencies in International Trade Transactions"**, submitted to the National University of Advanced Legal Studies, Kochi, in partial fulfillment of the requirements for the award of the degree of Master of Laws (LL.M.) in International Trade Law, is the result of my original and independent research undertaken under the guidance and supervision of Dr. Anil R. Nair.

I further affirm that this dissertation is a bona fide and legitimate academic work, pursued solely for academic purposes. To the best of my knowledge and belief, this work has not been submitted, either in whole or in part, for the award of any other degree or similar academic title at this or any other university or institution.

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ABBREVIATIONS

AEO	Authorized Economic Operator
AfCFTA	African Continental Free Trade Area
AML	Anti-Money Laundering
AMLD	Anti-Money Laundering Directive (EU)
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
BIS	Bank for International Settlements
BRICS	Brazil, Russia, India, China, South Africa
CASPs	Crypto-Asset Service Providers
CBDC	Central Bank Digital Currency
CDD	Customer Due Diligence
CFTC	Commodity Futures Trading Commission (U.S.)
CISG	United Nations Convention on Contracts for the International Sale of Goods
CPMI	Committee on Payments and Market Infrastructures
DAOs	Decentralized Autonomous Organizations
DEA	Digital Economy Agreement
DEPA	Digital Economy Partnership Agreement
DEX(s)	Decentralized Exchange(s)
DLT	Distributed Ledger Technology
DMA	Digital Markets Act (EU)
DSA	Digital Services Act (EU)
dApp(s)	Decentralized Application(s)
E-SIGN Act	Electronic Signatures in Global and National Commerce Act
eBL	Electronic Bill of Lading
eIDAS	Electronic Identification, Authentication and Trust Services (EU Regulation)
ePCS	Electronic Port Community System
ETA	Electronic Transactions Act (Singapore)
EU	European Union
FATF	Financial Action Task Force

FinCEN	Financial Crimes Enforcement Network (U.S.)
FSB	Financial Stability Board
G20	Group of Twenty
GATS	General Agreement on Trade in Services
GST	Goods and Services Tax
ICC	International Chamber of Commerce
IMDA	Infocomm Media Development Authority (Singapore)
IMF	International Monetary Fund
IOSCO	International Organization of Securities Commissions
IRS	Internal Revenue Service (U.S.)
IT Act, 2000	Information Technology Act, 2000 (India)
JSI	Joint Statement Initiative (WTO)
KYC	Know Your Customer
KoFIU	Korea Financial Intelligence Unit
LCIA	London Court of International Arbitration
MAS	Monetary Authority of Singapore
MiCA	Markets in Crypto-Assets Regulation (EU)
MLAC / MLAutoC	Model Law on Automated Contracting
MLEC	Model Law on Electronic Commerce
MLETR	Model Law on Electronic Transferable Records
NFTs	Non-Fungible Tokens
OECD	Organisation for Economic Co-operation and Development
OFAC	Office of Foreign Assets Control (U.S. Treasury)
PSA	Payment Services Act (Singapore)
RBI	Reserve Bank of India
SAARC	South Asian Association for Regional Cooperation
SEC	Securities and Exchange Commission (U.S.)
SEBI	Securities and Exchange Board of India
SIAC	Singapore International Arbitration Centre
SME	Small and Medium-sized Enterprise
TDS	Tax Deducted at Source
TFA	Trade Facilitation Agreement (WTO)

TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
U.S.	United States
UCC	Uniform Commercial Code (U.S.)
UKJT	U.K. Jurisdiction Taskforce
UNCITRAL	United Nations Commission on International Trade Law
UNIDROIT	International Institute for the Unification of Private Law
USMCA	United States–Mexico–Canada Agreement
USD	United States Dollar
VASPs	Virtual Asset Service Providers
WEF	World Economic Forum
WTO	World Trade Organization

LIST OF CASES

Sl. No.	Cases
1.	AA v. Persons Unknown, [2019] EWHC 3556 (Comm) (UK)
2.	B2C2 Ltd. v. Quoine Pte. Ltd., [2019] SGHC(I) 03 (Singapore International Commercial Court); [2020] SGCA(I) 02 (Singapore Court of Appeal)
3.	Internet and Mobile Ass'n of India v. Reserve Bank of India, (2020) 10 SCC 274 (Supreme Court of India)
4.	SEC v. W.J. Howey Co., 328 U.S. 293 (1946)
5.	United States v. 50.44 Bitcoins, No. CV 15-369, 2016 WL 3049166 (D. Md. May 31, 2016)

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CHAPTER 1

INTRODUCTION AND RESEARCH FRAMEWORK

1.1 Background

The emergence of blockchain technology has elicited a paradigm shift in the way data is stored, verified, and transferred. Originally developed to support the cryptocurrency Bitcoin in 2008[1], blockchain has since evolved into a foundational technology with transformative potential across multiple sectors, including finance, healthcare, supply chain management, and international trade.[2] A blockchain is a distributed, decentralized ledger that securely, transparently, and irrevocably records transactions. Each "block" contains a set of transactions, cryptographically linked to the previous one, forming a continuous and tamper-resistant chain.[3]

Cryptocurrencies, such as Bitcoin and Ethereum, are digital representations of value that rely on blockchain technology to enable peer-to-peer transfers without the need for traditional intermediaries like banks.[4] These digital currencies function independently of central banking authorities, operating instead on consensus-based protocols that validate transactions and maintain the integrity of the ledger.[5]

Beyond financial instruments, blockchain has enabled the evolution of "smart contracts," which are self-executing programs that, when certain requirements are fulfilled, automatically enforce the terms of an agreement.[6] These contracts are deployed on blockchain platforms like Ethereum and operate without the need for

[1] Satoshi Nakamoto, *Bitcoin: A Peer-to-Peer Electronic Cash System* (2008), https://bitcoin.org/bitcoin.pdf (last visited March 08, 2025).
[2] Riccardo de Caria, *A Digital Revolution in International Trade? The International Legal Framework Applicable to Blockchain Technologies, with a Focus on International Sale of Goods*, in UNCITRAL Congress 2017: Modernizing International Trade Law to Support Innovation and Sustainable Development 169 (2018).
[3] Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* 32–33 (Harvard Univ. Press 2018).
[4] Tobias Adrian & Tommaso Mancini-Griffoli, *The Rise of Digital Money*, IMF Fintech Notes No. 19/01, at 5–7 (2019), file:///C:/Users/acer/Downloads/FTNEA2019001%20(2).pdf.
[5] Org. for Econ. Co-operation & Dev. [OECD], *Regulatory Approaches to the Tokenisation of Assets* (2021), https://www.oecd.org/content/dam/oecd/en/publications/reports/2021/03/regulatory-approaches-to-the-tokenisation-of-assets_da7ae482/aea35466-en.pdf (last visited March 08, 2025).
[6] Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 Duke L.J. 313, 321–22 (2017).

human intervention, relying entirely on code to execute terms. [7] Smart contracts aim to eliminate ambiguity, reduce transaction costs, enhance transparency, and provide greater certainty in contractual performance. As such, they hold immense promise for commercial applications, particularly in scenarios where parties from different jurisdictions must engage in complex transactions.[8]

In the context of international trade, blockchain and smart contracts promise to significantly streamline cross-border transactions. The global trade ecosystem is traditionally characterized by heavy documentation, lengthy customs procedures, numerous intermediaries, and the risk of non-performance or fraud.[9] Blockchain technology, being immutable and decentralized, has the potential to overcome these challenges by facilitating the secure and instant verification of trade documents, the monitoring of goods in real-time, enforcing contract automatically.[10] Smart contracts, when integrated into trade finance mechanisms, can execute payments, release shipping instructions, or trigger insurance coverage automatically upon the occurrence of contractually defined events.

However, despite this transformative potential, legal systems around the world are struggling to adapt to the pace of innovation. Jurisdictional uncertainties, the legal status and enforceability of code-based agreements, inconsistencies in regulatory treatment, and a lack of harmonized standards remain major hurdles to the mainstream adoption of blockchain technology in international commerce.[11] Without appropriate legal systems, those parties who use blockchain to conduct their trade may find themselves without sufficient redress in the event of disputes, mistakes or non-compliance.

Apart from the transformational power smart contracts could unleash, the rise of cryptocurrencies as a new form of payment in international trade is gaining

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[7] Law Comm'n of Eng. & Wales, *Smart Legal Contracts: Advice to Government* (Nov. 2021), https://cognizium.io/uploads/resources/Law%20Commission%20-%20Smart%20Legal%20Contracts%20-%202021.pdf (last visited March 08, 2025).
[8] Pınar Çağlayan Aksoy, *Smart Contracts: To Regulate or Not? Global Perspectives*, 16 L. & Fin. Mkts. Rev. 212 (2024).
[9] World Econ. F., *Trade Tech: A New Age for Trade and Supply Chain Finance*, at 6–10 (2018), https://www3.weforum.org/docs/WEF_White_Paper_Trade_Tech_.pdf (last visited March 14, 2025).
[10] *Id*
[11] Mehdi El Harrak, *Do Smart Contracts Need New Conflict-of-Laws Rules?*, in Blockchain and Private International Law 221 (2022).

significance. Businesses are increasingly exploring the use of digital currencies such as Bitcoin and stablecoins for cross-border payments in place of traditional fiat currencies like the U.S. dollar.[12] Although such technologies offer benefits like quicker settlement and lower cost of transactions, they too have their own issues of a legal nature relating to regulatory acceptance, enforceability, volatility, and anti-money laundering regime.[13]

1.2 Research Problem

The core research problem addressed in this dissertation is the lack of legal clarity and enforceability surrounding blockchain-based smart contracts in cross-border transactions. While smart contracts are often praised for their efficiency, automation, and potential to revolutionize international trade, they also pose serious difficulties in terms of dispute resolution, contractual interpretation, and regulatory compliance. Traditional legal systems are built on assumptions that often do not hold in decentralized digital environments.

In a traditional contract, elements like offer and acceptance, consideration, the intention to form legal relationships, and the capacity to enter into the agreement are defined through textual documentation and human negotiation. Courts are best positioned to construe vague language, order fair remedies, and apply jurisdictional rules of the law of contract. Smart contracts, by contrast, are executed entirely by code, with terms encoded into logic and enforced by automation without the possibility of renegotiation or discretionary intervention. This poses a fundamental question: can code independently meet the legal requirements of a contract, especially in a cross-border case where there are conflicting legal traditions involved?

Moreover, when there is a dispute regarding a smart contract entered into among parties in different nations, courts would be at pains figuring out what national laws will apply, which courts will have jurisdiction, and if the code in itself forms a legally binding contract. The decentralized nature of blockchain networks complicates the application of private international law doctrines, such as the determination of the place of contract formation or the locus of contractual performance. Additionally, the absence of written

[12] Tobias Adrian & Tommaso Mancini-Griffoli, *The Rise of Digital Money*, Fintech Note No. 19/001 (Int'l Monetary Fund 2019), file:///C:/Users/acer/Downloads/FTNEA2019001%20(4).pdf (last visited March 14, 2025).
[13] *Id*

agreements or legally recognized digital signatures (as required under certain jurisdictions like India's Information Technology Act, 2000[14]) can create evidentiary hurdles in proving contractual intention and consent.

These issues are further compounded by the fragmented regulatory landscape surrounding blockchain and cryptocurrencies. While some jurisdictions have embraced the technology through enabling legislation or regulatory sandboxes, others have imposed outright bans or adopted a cautious approach.[15] This difference in legal standards creates a lot of uncertainty, especially for cross-border transactions. The enforceability of a smart contract can vary greatly depending on the governing law, the legal forum, and the specific obligations outlined in the contract.

For this reason, this dissertation aims to investigate whether our current legal frameworks are sufficient to tackle these issues. If they're not, it will look into the possibility of developing new legal norms, model laws, or institutional reforms that could help improve the enforceability of blockchain-based smart contracts in the realm of international trade.

Another pressing issue is the uncertainty surrounding the enforceability of international trade contracts denominated in cryptocurrencies. In jurisdictions where crypto-assets are not recognized as legal tender or where regulatory frameworks are ambiguous, parties face challenges in determining whether such contracts would be upheld by courts, especially in cross-border scenarios.[16]

1.3 Research Statement

While blockchain technology presents transformative potential for enhancing transparency, efficiency, and legal certainty in international trade transactions, its

[14] Information Technology Act, No. 21 of 2000, § 5, INDIA CODE (2000).
[15] Regulation (EU) 2023/1114 of the European Parliament and of the Council of 31 May 2023 on Markets in Crypto-Assets (MiCA), 2023 O.J. (L 150) 40.; Reserve Bank of India, *Enabling Framework for Regulatory Sandbox* (Aug. 13, 2019), https://www.rbi.org.in/Scripts/PublicationReportDetails.aspx?UrlPage=&ID=938 (last visited March 14, 2025).; Monetary Auth. of Sing., *FinTech Regulatory Sandbox Guidelines* (Jan. 1, 2022), https://www.mas.gov.sg/-/media/mas-media-library/development/regulatory-sandbox/sandbox/fintech-regulatory-sandbox-guidelines-jan-2022.pdf (last visited March 14, 2025).
[16] Fin. Action Task Force [FATF], *Updated Guidance for a Risk-Based Approach to Virtual Assets and VASPs* (Oct. 2021), https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Updated-Guidance-VA-VASP.pdf.coredownload.inline.pdf (last visited March 14, 2025).

integration into existing legal systems raises complex challenges. This study investigates the legal enforceability of blockchain-based smart contracts and critically examines the recognition and use of cryptocurrencies as a medium of exchange in cross-border commerce. By analyzing jurisdictional uncertainties, regulatory disparities, and doctrinal limitations, the research aims to contribute toward the development of harmonized legal frameworks for blockchain-enabled trade

1.4 Rationale and Significance of the Study

As international trade becomes increasingly digitized, the demand for secure, transparent, and efficient mechanisms for executing and verifying contracts has grown substantially. Blockchain technology and smart contracts offer innovative solutions to enduring challenges such as fraud, transactional delays, and information asymmetry in cross-border commerce. Yet, the absence of clear legal frameworks governing their use poses a serious obstacle to mainstream adoption.

Equally important is the rise of cryptocurrency-based payment systems, which promise to streamline international settlements by reducing reliance on traditional banking intermediaries, lowering transaction costs, and enhancing financial inclusion. However, their legal status varies across jurisdictions, and the lack of uniform regulatory treatment creates uncertainty for parties engaging in cross-border trade.

This study is significant in that it explores the intersection of law and emerging technologies, aiming to clarify how existing legal principles can adapt—or require reform—to accommodate blockchain-based smart contracts and cryptocurrency payments. The findings are intended to inform policymakers, legal practitioners, and international trade institutions in crafting harmonized, future-ready regulatory responses.

1.5 Theoretical Framework

This research is grounded in four key theoretical perspectives that guide the legal analysis of blockchain and cryptocurrency technologies in international trade.

First, **Decentralization Theory** advocates for reducing dependence on centralized institutions and resonates with blockchain's distributed ledger model, which facilitates peer-to-peer transactions and minimizes reliance on traditional intermediaries in global trade.[17]

Second, **Trust Theory** offers a conceptual foundation for understanding how blockchain technology replaces conventional institutional trust with algorithmic and cryptographic trust, thereby enhancing transparency, auditability, and transactional certainty across jurisdictions.[18] Together, these theories provide a normative and practical lens for examining the tension between code-based and law-based mechanisms of contract formation and enforcement.

In parallel, the study draws upon **Currency Substitution Theory**, which explains the economic and behavioral drivers behind the replacement of sovereign currencies with alternative forms of money, particularly in contexts of volatility, inflation, or regulatory friction.[19]

Finally, **Legal Pluralism Theory** helps contextualize how legal systems interact with non-state normative orders, such as decentralized financial ecosystems, offering a valuable framework for analyzing the fragmented and evolving legal treatment of cryptocurrencies across jurisdictions.[20]

Collectively, these perspectives provide a robust theoretical foundation for assessing how legal norms may adapt—or struggle to adapt—to the challenges posed by blockchain-enabled smart contracts and cryptocurrency-denominated trade transactions.

1.6 Review of Existing Research

Although the technical capabilities of blockchain technology have been widely explored, legal scholarship on its enforceability within the context of international trade remains relatively underdeveloped. Studies till now tend to focus on issues such as

[17] Nakamoto, *supra* note 1, at 1
[18] Werbach & Cornell, *supra* note 6, at 322.
[19] Tobias Adrian & Tommaso Mancini-Griffoli, *The Rise of Digital Money*, IMF Fintech Notes No. 19/01, at 9–11 (2019), file:///C:/Users/acer/Downloads/FTNEA2019001%20(2).pdf.
[20] Brian Z. Tamanaha, *Understanding Legal Pluralism: Past to Present, Local to Global*, 30 Sydney L. Rev. 375, 375–411 (2008).

jurisdictional ambiguity, regulatory fragmentation, and the conceptual validity of smart contracts, yet they often overlook the practical implications these legal uncertainties pose for international commercial actors.

Similarly, while there is a growing body of literature examining domestic regulatory approaches to cryptocurrencies, comparatively little attention has been given to the use of crypto-assets as a medium of exchange in international trade. In particular, the enforceability of crypto-denominated contracts across jurisdictions and their compatibility with existing trade law instruments, such as the United Nations Convention on Contracts for the International Sale of Goods (CISG)[21] and the UNCITRAL Model Law on Electronic Commerce (1996)[22], the UNCITRAL Model Law on Electronic Transferable Records (2017)[23], and the recently adopted UNCITRAL Model Law on Automated Contracting (2024)[24]—remains underexplored in both legal theory and practice.

Moreover, existing comparative legal studies on blockchain and smart contract enforceability remain fragmented, with few works providing jurisdictionally integrated frameworks for cross-border trade applications. This dissertation contributes to closing these gaps by undertaking a comparative legal analysis of blockchain-based smart contracts and cryptocurrency payment systems. In doing so, it builds upon and diverges from existing literature by addressing enforceability challenges across multiple jurisdictions, with a focus on harmonization of international legal standards.

1.7 Objectives of the Study

The primary objectives of this research are:

1. To examine the technological and legal characteristics of smart contracts and blockchain, with an emphasis on their applicability in international trade

[21] U.N. Convention on Contracts for the International Sale of Goods (CISG), Apr. 11, 1980, 1489 U.N.T.S. 3.
[22] UNCITRAL Model Law on Electronic Commerce, G.A. Res. 51/162, U.N. GAOR, 51st Sess., Supp. No. 49, U.N. Doc. A/RES/51/162 (Dec. 16, 1996).
[23] U.N. Comm'n on Int'l Trade Law, *UNCITRAL Model Law on Electronic Transferable Records*, U.N. Doc. A/71/17, Annex II (2017).
[24] U.N. Comm'n on Int'l Trade Law, *UNCITRAL Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited March 14, 2025).

transactions.

2. To analyze the enforceability of smart contracts under existing legal systems, particularly in cross-jurisdictional contexts.
3. To identify and evaluate the jurisdictional, evidentiary, and regulatory challenges posed by smart contracts.
4. To assess the effectiveness of current international frameworks, such as the CISG, UNCITRAL Model Laws, and national legislation, in governing blockchain-based trade agreements.
5. To explore the approaches adopted by different jurisdictions (including the US, EU, Singapore, and India) toward regulating smart contracts and blockchain-based commercial arrangements.
6. To propose potential legal reforms, model laws, or harmonization strategies to enhance the global enforceability of smart contracts in international commercial transactions.
7. To analyze the legal enforceability of cryptocurrency-denominated payments in cross-border trade transactions.
8. To assess the treatment of crypto payments under international legal frameworks such as the CISG and UNCITRAL model laws.

1.8 Scope and Limitations

This dissertation focuses on the enforceability of blockchain-enabled smart contracts in cross-border trade transactions. It is primarily concerned with issues arising under private law—such as contract formation, interpretation, performance, and dispute resolution—rather than matters of public law or criminal regulation, including taxation, money laundering, or securities oversight.

The analysis draws upon legal frameworks and developments in four key jurisdictions: the United States, the European Union, Singapore, and India. These were selected due to their significant roles in global trade, active engagement with emerging technologies, and representation of diverse legal traditions, including common law, civil law, and hybrid systems. The comparative perspective aims to highlight varying approaches to the recognition, regulation, and enforcement of smart contracts across different legal systems.

International legal instruments such as the United Nations Convention on Contracts for the International Sale of Goods[25] (CISG), the UNCITRAL Model Law on Electronic Commerce (1996)[26], the UNCITRAL Model Law on Electronic Transferable Records (2017)[27] and the recently adopted UNCITRAL Model Law on Automated Contracting (2024)[28] are examined for their relevance to blockchain-based contractual arrangements. Regional initiatives, including the European Union's Digital Services Act[29], Data Act[30], and Markets in Crypto-Assets (MiCA) Regulation[31], are also considered in assessing the evolving regulatory landscape for smart contract enforceability.

The study does not examine blockchain applications unrelated to international trade, such as non-fungible tokens (NFTs), decentralized autonomous organizations (DAOs), blockchain-based voting systems, or social media platforms. Nor does it delve into the technical architecture, design, or programming languages underlying blockchain or smart contracts. Instead, the analysis is focused on legal implications, doctrinal enforceability, and the interaction between existing legal norms and emerging technologies.

While the primary emphasis is on smart contracts, the dissertation also evaluates the legal viability of using cryptocurrencies—such as Bitcoin and stablecoins—as a medium of exchange in cross-border trade. This subsidiary inquiry focuses on the legal enforceability and regulatory treatment of cryptocurrency payments insofar as they intersect with international trade law.

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[25] CISG, supra note 21.
[26] U.N. Comm'n on Int'l Trade Law, UNCITRAL Model Law on Electronic Commerce with Guide to Enactment 1996, U.N. Sales No. E.99.V.4 (1999), https://uncitral.un.org/sites/uncitral.un.org/files/media-documents/uncitral/en/19-04970_ebook.pdf (last visited March 14, 2025).
[27] U.N. Comm'n on Int'l Trade Law, *UNCITRAL Model Law on Electronic Transferable Records*, U.N. Doc. A/71/17, Annex II (2017).
[28] U.N. Comm'n on Int'l Trade Law, *UNCITRAL Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf.
[29] Regulation (EU) 2022/2065 of the European Parliament and of the Council of 19 Oct. 2022 on a Single Market for Digital Services and Amending Directive 2000/31/EC (Digital Services Act), 2022 O.J. (L 277) 1.
[30] Regulation (EU) 2023/2854 of the European Parliament and of the Council of 13 Dec. 2023 on Harmonised Rules on Fair Access to and Use of Data (Data Act), 2023 O.J. (L 2023) 1.
[31] Regulation (EU) 2023/1114 of the European Parliament and of the Council of 31 May 2023 on Markets in Crypto-Assets (MiCA), 2023 O.J. (L 150) 40.

1.9 Chapterisation

This dissertation consists of six chapters, each addressing a specific dimension of blockchain and cryptocurrency technologies in the context of international trade law.

- **Chapter 1: Introduction and Research Framework** – Introduces the dissertation by outlining the background of blockchain and cryptocurrency technologies in international trade. It sets out the research problem, objectives, research questions, methodology, rationale, theoretical framework, and limitations of the study.
- **Chapter 2: Legal and Technical Foundations of Blockchain-Based Trade Transactions** - This chapter integrates the theoretical foundations, literature review, and technical discussion on blockchain, smart contracts, and cryptocurrencies. It also addresses the international legal instruments applicable to blockchain trade—such as the UNCITRAL Model Laws, CISG, WTO e-commerce instruments, and Hague principles. Content from the previously separate chapters on theoretical perspectives and trade finance use-cases is consolidated here.
- **Chapter 3: Legal Challenges in Blockchain and Cryptocurrency Integration in International Trade** - Focuses on the legal complexities related to contract enforceability, jurisdictional conflicts, and conflict-of-laws doctrines in blockchain-based trade transactions. It expands on content originally presented in chapters dealing with legal challenges and smart contract enforceability.
- **Chapter 4: Comparative Legal Approaches to Smart Contracts and Cryptocurrency Payments** - Provides a jurisdictional analysis of how selected countries—namely the United States, European Union, Singapore, and India—regulate smart contracts and cryptocurrency in trade. This chapter builds on the originally proposed comparative framework, offering critical legal contrasts, enforcement approaches, and trade integration implications.
- **Chapter 5: Policy Reform Proposals for Harmonizing Smart Contract and Crypto Trade Laws** - Based on the findings of the earlier chapters, this section presents concrete legal and institutional recommendations. It advocates for harmonized legal models, proposes doctrinal adaptations, and discusses the role

of bodies like UNCITRAL, WTO, FATF, and BIS. Special emphasis is placed on India and Global South perspectives.

- **Chapter 6: Conclusion and Future Directions** - Concludes the dissertation by synthesizing major findings, restating the contribution to legal scholarship, and identifying pathways for future research and legal development in the evolving intersection of blockchain, cryptocurrencies, and international trade law.

CHAPTER 2

LEGAL AND TECHNICAL FOUNDATIONS OF BLOCKCHAIN-BASED TRADE TRANSACTIONS

2.1 Introduction

The introduction of blockchain technology to international trade has transformed conventional legal frameworks by decentralizing authority, facilitating automatic transactions, and establishing new mechanisms for value transfer. As global commerce transitions toward digitization, the legal foundations governing cross-border trade must evolve to address the challenges and opportunities brought by blockchain based systems. This chapter explores the fundamental legal and technical principles of blockchain, smart contracts, and cryptocurrencies, identifying their role in international trade and examining the foundational instruments and doctrines that shape their legal treatment.

Blockchain represents a paradigm shift from centralized, institution-led governance to decentralized, peer-validated networks that operate through consensus algorithms. Traditional international trade systems have long relied on regulated intermediaries—such as banks, shipping agents, and arbitration institutions—to ensure compliance and trust. Blockchain disrupts this model by embedding transactional rules directly into code, often rendering human discretion and institutional control secondary. This raises significant questions about how national legal systems and international instruments should respond to systems that defy conventional structures of liability, documentation, and jurisdiction.

The analysis in this chapter draws upon interdisciplinary insights from legal scholarship, regulatory reports, and institutional frameworks. Sources include peer-reviewed journals, legal treatises, and policy documents issued by international institutions such as UNCITRAL, the World Trade Organization (WTO), the International Monetary Fund (IMF), and the Financial Action Task Force (FATF)[32]. A

[32] U.N. Comm'n on Int'l Trade Law, UNCITRAL Model Law on Electronic Transferable Records, U.N. Doc. A/71/17, Annex II (2017).; Int'l Monetary Fund & Fin. Stability Bd., IMF-FSB Synthesis Paper: Policies for Crypto-Assets (Sept. 2023), https://www.fsb.org/uploads/R070923-1.pdf (last visited March 14, 2025).; Fin. Action Task Force [FATF], Updated Guidance for a Risk-Based Approach to Virtual

jurisdictional focus on the European Union, the United States, India, and Singapore has been adopted for their legal diversity and global trade relevance. By integrating decentralization theory, trust theory, and legal pluralism into the analysis, the chapter also contextualizes how blockchain challenges existing legal doctrines while offering new avenues for regulatory innovation.[33]

Ultimately, this chapter provides the legal and technical scaffolding needed to examine blockchain's enforceability within international trade. It highlights the doctrinal and jurisdictional gaps that emerge when decentralized systems interact with centralized legal orders, setting the stage for the comparative and doctrinal analyses that follow in subsequent chapters.

2.2 Conceptualizing Blockchain and Cryptocurrency in Legal Discourse

Blockchain is commonly defined as a decentralized, tamper-proof, distributed ledger technology that enables peer-to-peer transactions without reliance on a central authority.[34] From a legal standpoint, its implications challenge conventional structures of regulation, contract enforcement, and dispute resolution. Among the most talked-about blockchain applications are cryptocurrencies like Bitcoin and Ethereum, which are frequently seen as digital assets, trade channels, or accounting units. However, their legal classification remains hotly contested under national laws, raising concerns around monetary sovereignty, taxation, and regulatory consistency.

Legal scholars approach blockchain's impact from both optimistic and critical perspectives**.** On the optimistic side, Don and Alex Tapscott conceptualize blockchain as a revolutionary tool for enhancing digital governance, decentralizing authority, and improving transactional trust and efficiency.[35] Similarly, Primavera De Filippi and Aaron Wright further argue that blockchain constitutes a new modality of legal

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Assets and VASPs (Oct. 2021), https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Updated-Guidance-VA-VASP.pdf.coredownload.inline.pdf (last visited March 14, 2025).

[33] See Kevin Werbach, *The Blockchain and the New Architecture of Trust* (MIT Press 2018); Brian Z. Tamanaha, *Understanding Legal Pluralism: Past to Present, Local to Global*, 30 Sydney L. Rev. 375 (2008); Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* (Harvard Univ. Press 2018).

[34] Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* 32–33 (Harvard Univ. Press 2018).

[35] Don Tapscott & Alex Tapscott, *Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies Is Changing the World* 3–10 (2016).

ordering, giving rise to *"lex cryptographia"*, in which code displaces traditional law as the primary governance mechanism.[36]

In contrast, Kevin Werbach critiques the myth of "trustless" systems, contending that blockchain does not eliminate trust but redistributes it—often to system designers, coders, and node operators, who remain largely unregulated.[37] Angela Walch supports this cautionary view by highlighting the "ideological opacity" and legal unaccountability of blockchain developers, arguing that they act as unacknowledged fiduciaries or power brokers in decentralized ecosystems.[38]

Another major area of debate lies in the legal classification and taxonomy of crypto-assets**.** Jurisdictions differ significantly: some consider crypto-assets as commodities (e.g., CFTC in the U.S.), others as securities (SEC), and some define them sui generis.[39] These definitional ambiguities influence contract enforceability, taxation, and legal remedies. The European Union's Markets in Crypto-Assets Regulation (MiCA), adopted in 2023, attempts to resolve this by categorizing digital assets into e-money tokens, asset-referenced tokens, and other crypto-assets, each with distinct regulatory obligations.[40]

This fragmented legal taxonomy directly affects how smart contracts—self-executing digital agreements—interact with established legal norms. Smart contracts embed agreement terms in code, often lacking the nuance required in traditional contracts. Scholars such as Werbach and Cornell have warned that this deterministic rigidity may undermine essential legal functions like equitable remedies, renegotiation, and judicial discretion.[41]

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[36] Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* 9–40 (Harvard Univ. Press 2018).
[37] Kevin Werbach, *Trust, but Verify: Why the Blockchain Needs the Law*, 33 Berkeley Tech. L.J. 489, 494–504 (2018).
[38] Angela Walch, *Deconstructing "Decentralization": Exploring the Core Claim of Crypto Systems, in Cryptoassets: Legal, Regulatory, and Monetary Perspectives* 39, 41–50 (Chris Brummer ed., Oxford Univ. Press 2019).
[39] See, e.g., U.S. Commodity Futures Trading Commission, *In the Matter of Coinflip, Inc.*, CFTC No. 15-29 (Sept. 17, 2015); U.S. Securities and Exchange Commission, *Report of Investigation Pursuant to Section 21(a) of the Securities Exchange Act of 1934: The DAO*, Release No. 81207 (July 25, 2017); European Banking Authority, *Report with Advice for the European Commission on Crypto-Assets* 8–12 (Jan. 2019).
[40] Regulation 2023/1114, of the European Parliament and of the Council of 31 May 2023 on Markets in Crypto-assets, and amending Regulations (EU) No 1093/2010, (EU) No 1094/2010, and (EU) No 1095/2010.
[41] Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 Duke L.J. 313, 320–336 (2017).

As such, this section highlights a growing body of interdisciplinary scholarship grappling with how emerging technologies interface with legacy legal doctrines. The challenge lies in ensuring that technological innovation proceeds without eroding the core principles of legality, consent, and enforceability that underpin international trade law.

2.3 Blockchain Applications in International Trade

Blockchain technology has gained increasing attention in the field of international trade due to its ability to streamline intricate logistical procedures, improve transparency, lower fraud, and boost transactional efficiency. The core appeal lies in its decentralized, immutable ledger system, which provides a shared source of truth for all parties involved in cross-border commerce, from exporters and importers to banks, insurers, and customs authorities.

Despite its promising applications, real-world implementation has encountered significant obstacles. One of the most illustrative examples is the rise and fall of TradeLens, a blockchain-based digital shipping platform developed jointly by Maersk and IBM.[42] Launched with the intent to revolutionize the shipping industry by offering a permissioned blockchain for global supply chain tracking, TradeLens aimed to bring together various stakeholders—port operators, shipping lines, and customs agencies—onto a single secure platform.[43] However, the platform was discontinued in early 2023 after failing to achieve sufficient industry-wide collaboration.[44] The limited participation of rival shipping carriers and the reluctance of ecosystem actors to entrust data to a platform co-owned by a competitor contributed to its commercial failure.[45]

Additionally, TradeLens faced practical hurdles, including high integration costs, organizational inertia, and legal uncertainty regarding data sharing and liability allocation. These challenges demonstrate that the technological feasibility of blockchain

[42] A.P. Moller–Maersk & IBM, *Maersk and IBM to Discontinue TradeLens Blockchain Platform*, Maersk Newsroom (Nov. 29, 2022), https://www.maersk.com/news/articles/2022/11/29/maersk-and-ibm-to-discontinue-tradelens (last visited March 14, 2025).
[43] *Id.*
[44] Edwin Lopez, *Maersk, IBM to Shut Down Blockchain Joint Venture TradeLens*, Supply Chain Dive (Nov. 30, 2022), https://www.supplychaindive.com/news/Maersk-IBM-shut-down-TradeLens/637580/ (last visited March 14, 2025).
[45] *The Closure of TradeLens: When Technology Is Not Enough*, PierNext (Jan. 26, 2023), https://piernext.portdebarcelona.cat/en/technology/the-closure-of-tradelens/ (last visited March 14, 2025).

solutions alone is insufficient—adoption relies heavily on governance design, interoperability, and legal trust among ecosystem participants.[46]

In parallel, international institutions such as the World Economic Forum (WEF) and the World Trade Organization (WTO) have explored blockchain's trade-related applications with a more policy-oriented and collaborative focus. The WTO has acknowledged blockchain's ability to streamline documentary processes, particularly in relation to customs declarations, certificates of origin, and trade financing. Their reports emphasize the importance of regulatory harmonization and digital infrastructure development for scaling blockchain solutions globally.[47]

The WEF, in its Blockchain Deployment Toolkit, has advocated for regulatory sandboxes, multi-stakeholder dialogue, and a shift away from isolated private platforms toward interoperable ecosystems that serve the broader trade infrastructure.[48]

Likewise, the Organisation for Economic Co-operation and Development (OECD) has produced evaluative reports on pilot blockchain deployments in trade finance and global value chains. These reports underline the technology's potential to reduce transaction times and increase traceability**,** while also flagging the persistent issues of cross-border legal enforceability and regulatory divergence as critical barriers to large-scale implementation.[49]

These pilot experiences and institutional reports collectively highlight that blockchain has meaningful potential to transform trade processes. But its advantages won't be completely recognized unless accompanied by legal certainty, regulatory coherence, and robust multilateral cooperation—themes that will be further examined in subsequent chapters of this dissertation.

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[46] *Id.*

[47] Emmanuelle Ganne, *Can Blockchain Revolutionize International Trade?*, WTO Staff Working Paper ERSD-2018-10, at 12–15 (2018), https://www.wto.org/english/res_e/booksp_e/blockchainrev18_e.pdf (last visited March 14, 2025).

[48] World Economic Forum, *Redesigning Trust: Blockchain Deployment Toolkit*, at 8–25 (2020), https://widgets.weforum.org/blockchain-toolkit/pdf/WEF_Redesigning_Trust_Blockchain_Deployment%20Toolkit.pdf (last visited March 14, 2025).

[49] Organisation for Economic Co-operation and Development, *Blockchain at the Frontier: Blockchain's Impact on International Trade and Global Value Chains*, OECD Publishing (2022).

2.3.1 Smart Contracts in International Trade Transactions

Smart contracts are self-executing agreements encoded on blockchain platforms that autonomously enforce the terms of a transaction once predefined conditions are satisfied. In the context of international trade, these contracts offer a streamlined and automated alternative to traditional paper-based processes. They can facilitate faster payments, improve cargo tracking, reduce reliance on intermediaries, and enhance compliance with complex logistical requirements. This builds upon the foundational definition provided in Chapter 1, which emphasized the automation and enforcement functions of smart contracts in a decentralized digital ecosystem.

Despite these technical advantages, the doctrinal enforceability of smart contracts remains a subject of debate across legal systems. As Kevin Werbach and Nicolas Cornell explain, in common law jurisdictions such as the United Kingdom and the United States, enforceability hinges on foundational principles like offer, acceptance, consideration, and intention to create legal relations. A critical challenge arises in determining whether code-based interactions meet these requirements. Smart contracts often lack natural language provisions, making it difficult to interpret whether parties genuinely intended to be legally bound or understood the implications of the code being executed.[50]

In contrast, civil law systems (e.g., France, Germany, Japan) tend to emphasize the expression of will and objective intent over the formalistic requirement of consideration. This could theoretically make smart contracts more adaptable to civil law contexts, but issues remain regarding legal capacity**,** informed consent, and error (or defect of will) where non-technical users engage with code whose function they may not fully grasp.[51]

Legal scholars have raised concerns about the limitations of using code as a substitute for legal language. Max Raskin analogizes smart contracts to vending machines—transactions that occur automatically based on predetermined logic, but which lack the capacity to adapt to nuance, ambiguity, or changed circumstances.[52] Kevin Werbach and Nicolas Cornell argue that while smart contracts may be efficient, they lack

[50] Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 Duke L.J. 313, 320–336 (2017).
[51] Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* 67–73 (Harvard Univ. Press 2018).
[52] Max Raskin, *The Law and Legality of Smart Contracts*, 1 Geo. L. Tech. Rev. 305, 307–11 (2017).

flexibility and fail to provide room for equitable remedies like rescission or reformation in cases of mistake or unconscionability.[53] Similarly, Primavera De Filippi & Samer Hassan critiques the notion of "code is law," observing that smart contracts, while technically enforceable, can bypass traditional legal safeguards and limit accountability, especially in cross-border settings where jurisdiction and applicable law are unclear.[54]

A further complexity arises in the evidentiary treatment and cross-border enforcement of smart contracts. Questions of jurisdiction, governing law, and the admissibility of code as evidence complicate their recognition in international trade disputes. Without harmonized interpretive frameworks or judicial precedent, courts may struggle to determine whether code alone suffices as proof of contract and how to interpret intent when human-readable documentation is absent.[55]

Accordingly, while smart contracts hold significant potential in automating and optimizing international trade transactions, their legal enforceability remains contingent on the evolution of both national doctrines and transnational legal harmonization. Recognition of code-based agreements must be paired with judicial capacity-building, interpretive guidance, and procedural safeguards to ensure their effective use in global commerce.

2.3.2 Cryptocurrency as a Medium of Exchange in Trade

The growing adoption of cryptocurrencies in international commerce has introduced a new class of assets that challenge traditional notions of legal tender, payment settlement, and monetary sovereignty. While early cryptocurrencies such as Bitcoin were primarily speculative and volatile, the evolution of stablecoins and proposals for central bank digital currencies (CBDCs) have sparked renewed interest in using these digital instruments for trade settlements.[56]

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[53] Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 Duke L.J. 313, 344–350 (2017).
[54] Primavera De Filippi & Samer Hassan, *Blockchain Technology as a Regulatory Technology: From Code is Law to Law is Code*, 13 First Monday, no. 12 (Dec. 3, 2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3097430 (last visited March 14, 2025).
[55] U.N. Comm'n on Int'l Trade Law, *UNCITRAL Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited March 14, 2025).
[56] Tobias Adrian & Tommaso Mancini-Griffoli, *The Rise of Digital Money*, IMF Fintech Notes No. 19/01, at 9–11 (2019), file:///C:/Users/acer/Downloads/FTNEA2019001%20(2).pdf.

In international trade, cryptocurrency offers the potential to reduce transaction costs, eliminate intermediary delays, and enhance transparency in cross-border payments.[57] It may also support access to global markets for parties in jurisdictions with limited banking infrastructure. Stablecoins, which are typically pegged to fiat currencies or commodities, offer a more stable medium of exchange and are increasingly being tested in trade finance platforms and cross-border remittance systems.[58]

A notable case is El Salvador's adoption of Bitcoin as legal tender, the first of its kind, which was driven by a desire to reduce reliance on foreign remittance intermediaries and enhance national financial inclusion.[59] Although symbolically powerful, this move has been met with criticism by global financial institutions due to concerns over volatility, transparency, and long-term macroeconomic risks.[60]

The International Monetary Fund (IMF) has cautioned against unregulated crypto adoption in national payment systems, citing risks to monetary policy, capital controls, and exchange rate stability.[61] The IMF and the Financial Stability Board (FSB) jointly released a roadmap in 2023 outlining a coordinated global response to crypto-assets, emphasizing the need for consistent standards, cross-border information sharing, and legal clarity.[62] This roadmap was endorsed by the G20 and aims to provide a multilayered framework for mitigating systemic risks posed by crypto in international finance.[63]

Legal challenges also arise in the classification of cryptocurrencies within trade contracts. Under frameworks like the United Nations Convention on Contracts for the International Sale of Goods (CISG), there is no explicit restriction on denominating

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[57] Int'l Monetary Fund & Fin. Stability Bd., *IMF-FSB Synthesis Paper*: *Policies for Crypto-Assets* (Sept. 2023), https://www.fsb.org/uploads/R070923-1.pdf (last visited March 28, 2025).
[58] Bank for Int'l Settlements, *CBDCs: Opportunities and Challenges*, in Annual Economic Report (2021), https://www.bis.org/publ/arpdf/ar2021e.pdf (last visited March 28, 2025).
[59] Decreto No. 57, Bitcoin Law, June 8, 2021, art. 1 (El Sal.).
[60] See International Monetary Fund, El Salvador: 2023 Article IV Consultation—Press Release; Staff Report; and Statement by the Executive Director for El Salvador, IMF Country Report No. 25/67 (Mar. 2025), file:///C:/Users/acer/Downloads/1slvea2025002-print-pdf%20(3).pdf.
[61] Int'l Monetary Fund, *The Crypto Ecosystem and Financial Stability Challenges*, Global Financial Stability Report, at 14–20 (Oct. 2021), file:///C:/Users/acer/Downloads/9781513595603-front-1.pdf (last visited March 28, 2025).
[62] Int'l Monetary Fund & Fin. Stability Bd., *IMF-FSB Synthesis Paper*: *Policies for Crypto-Assets* (Sept. 2023), https://www.fsb.org/uploads/R070923-1.pdf (last visited March 28, 2025).
[63] G20, Leaders' Declaration: G20 New Delhi Summit 2023 ¶ 58 (Sept. 9–10, 2023), https://www.mea.gov.in/Images/CPV/G20-New-Delhi-Leaders-Declaration.pdf (last visited March 28, 2025).

obligations in non-fiat assets. However, there is ambiguity around enforceability, valuation, and lex monetae principles when obligations are stated in cryptocurrencies or stablecoins. Questions persist regarding whether crypto can constitute "payment" under domestic laws that narrowly define legal tender.[64]

UNCITRAL, while not directly addressing cryptocurrencies in its existing model laws, recognized the growing need for legal systems to adapt to digitized value transfer. In its Model Law on Electronic Transferable Records (2017), UNCITRAL laid the groundwork for recognizing electronically transferable payment instruments.[65] Its recently adopted Model Law on Automated Contracting (2024) opens the door for broader interpretation of non-fiat and algorithmic value systems within the legal domain, including smart contract-based obligations and blockchain-facilitated transactions.[66]

The Financial Action Task Force (FATF) has been instrumental in issuing regulatory guidance for Virtual Asset Service Providers (VASPs), especially concerning anti-money laundering (AML) and counter-terrorism financing (CTF) compliance. FATF's Travel Rule now applies to crypto exchanges, requiring data-sharing on payer and payee information for international crypto transfers.[67]

Moreover, the currency substitution theory—which considers the replacement of domestic currency with a foreign or digital equivalent—offers insight into potential systemic shifts. It highlights how crypto adoption in international trade may diminish the control of national monetary authorities and destabilize domestic financial institutions. The IMF and BIS have proposed that CBDCs, particularly when interoperable across jurisdictions, offer a safer and more controllable path toward

[64] United Nations Convention on Contracts for the International Sale of Goods, Apr. 11, 1980, 1489 U.N.T.S. 3.
[65] UNCITRAL Model Law on Electronic Transferable Records, G.A. Res. 71/313, U.N. Doc. A/RES/71/313 (July 13, 2017).
[66] U.N. Comm'n on Int'l Trade Law, *UNCITRAL Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited March 28, 2025).
[67] Fin. Action Task Force [FATF], *Updated Guidance for a Risk-Based Approach to Virtual Assets and VASPs,* at 25-32 (Oct. 2021), https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Updated-Guidance-VA-VASP.pdf.coredownload.inline.pdf (last visited March 28, 2025).

digitized global trade settlements, as exemplified by the mBridge project led by Hong Kong, Thailand, China, and the UAE.[68]

In conclusion, while cryptocurrency offers undeniable efficiency in cross-border trade, its full potential is constrained by legal ambiguities, jurisdictional inconsistencies, and regulatory concerns. To legitimize crypto-denominated trade contracts, international legal instruments and domestic contract doctrines must evolve to accommodate digital value units as enforceable and recognizable means of settlement.

2.4 Role of International Legal Instruments

Existing international trade law instruments are in the early stages of adapting to blockchain technologies. The United Nations Convention on Contracts for the International Sale of Goods (CISG) does not explicitly address smart contracts or blockchain-facilitated transactions. Nevertheless, core principles such as party autonomy, offer and acceptance, and functional equivalence may be applied analogically to certain blockchain-based commercial arrangements.[69]

The United Nations Commission on International Trade Law (UNCITRAL) has laid foundational groundwork through its 1996 Model Law on Electronic Commerce and the 2017 Model Law on Electronic Transferable Records, both of which support the use of electronic documents and digital signatures. More recently, the 2024 UNCITRAL Model Law on Automated Contracting demonstrates an evolving recognition of smart contracts within the framework of international legal harmonization.[70]

In the European context, regulatory instruments such as the Digital Services Act (DSA), Digital Markets Act (DMA), and the Data Act collectively offer a legal infrastructure for overseeing decentralized and data-driven systems.[71] These are complemented by the

[68] Bank for Int'l Settlements et al., *Project mBridge: Connecting Economies Through CBDC* (Sept. 2022), https://www.bis.org/publ/othp59.pdf.
[69] United Nations Convention on Contracts for the International Sale of Goods, Apr. 11, 1980, 1489 U.N.T.S. 3.
[70] UNCITRAL *Model Law on Electronic Commerce*, G.A. Res. 51/162, U.N. Doc. A/RES/51/162 (Jan. 30, 1997); UNCITRAL *Model Law on Electronic Transferable Records*, U.N. Doc. A/RES/71/228 (Dec. 23, 2016); UNCITRAL Working Group IV, *Legal Issues of Automated Contracting*, A/CN.9/WG.IV/WP.167 (2024).
[71] See, e.g., Regulation 2022/2065, 2022 O.J. (L 277) 1 (EU) (*Digital Services Act*); Regulation 2022/1925, 2022 O.J. (L 265) 1 (EU) (*Digital Markets Act*); Regulation 2023/2854, 2023 O.J. (L 2023/2854) 1 (EU) (*Data Act*).

Markets in Crypto-Assets (MiCA) Regulation, which specifically addresses the classification, governance, and supervision of crypto-assets within the EU.[72]

In the multilateral context, the World Trade Organization (WTO) has initiated regulatory frameworks for digital trade through its Work Programme on Electronic Commerce. Although not legally binding, the ongoing Joint Statement Initiative (JSI) aims to clarify global norms on cross-border data flows, electronic signatures, and paperless trading—issues directly relevant to blockchain-based trade facilitation. These efforts, while still under negotiation, demonstrate an emerging consensus on the need for harmonized digital trade rules at the WTO level.[73]

Despite these regulatory advances, substantial challenges persist. Notably, the enforcement of KYC (Know Your Customer) and AML (Anti-Money Laundering) regulations in decentralized ecosystems remains at odds with the privacy-preserving ethos of blockchain architecture.[74] Scholars such as Brechlin and Schäfer contend that while regulatory convergence is essential, attempts to impose uniform frameworks must remain sensitive to the decentralized and transjurisdictional nature of distributed ledger technologies.[75]

These tensions underscore the urgent need to develop interoperable and adaptive legal frameworks that align with both technological innovation and fundamental legal principles. As blockchain-based trade mechanisms continue to gain prominence, international legal instruments must evolve to ensure predictability, enforceability, and technological neutrality across diverse legal systems.

In addition, the Hague Principles on the Choice of Law in International Commercial Contracts (2015)[76] provide soft law guidance on determining applicable law in international contracts where state parties are undefined or variable—a scenario that increasingly describes smart contracts executed over decentralized blockchain

[72] Regulation 2023/1114, 2023 O.J. (L 150) 40 (EU).
[73] See World Trade Organization, *Work Programme on Electronic Commerce*, WTO Doc. WT/L/274 (Nov. 30, 1998); *Joint Statement Initiative on E-Commerce*, WTO Doc. INF/ECOM/1 (Jan. 25, 2019).
[74] See also Financial Action Task Force [FATF], *Updated Guidance for a Risk-Based Approach to Virtual Assets and VASPs* (Oct. 2021), https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Updated-Guidance-VA-VASP.pdf.coredownload.inline.pdf (last visited March 28, 2025).
[75] Thomas Brechlin & Florian Schäfer, Blockchain Regulation and Legal Pluralism, 26 J. INT'L Econ. L. 101 (2023).
[76] See Hague Conference on Private International Law, *Principles on Choice of Law in International Commercial Contracts* (2015), https://assets.hcch.net/docs/5da3ed47-f54d-4c43-aaef-5eafc7c1f2a1.pdf.

networks. Although not binding, these Principles are particularly relevant for addressing legal uncertainty in cross-border blockchain transactions where parties may operate pseudonymously across multiple jurisdictions.

2.5 Literature Gaps and Research Needs

Despite a growing body of literature, significant gaps remain:

- Limited empirical analysis of blockchain-based trade platforms and their enforceability.
- Lack of doctrinal clarity on how smart contracts fit into existing legal frameworks, especially in cross-border contexts.
- Insufficient exploration of private international law conflicts arising from decentralized transactions.
- Need for comparative legal analysis between civil law and common law jurisdictions on digital contracts.
- Minimal integration of blockchain developments into mainstream trade dispute mechanisms.

The preceding analysis reveals that while blockchain technologies offer considerable advantages in automating and securing international trade processes, the corresponding legal frameworks remain fragmented and uneven across jurisdictions. Key challenges include the enforceability of smart contracts, classification of crypto-assets, recognition of electronic documentation, and regulatory oversight of decentralized platforms. Although jurisdictions such as the European Union and Singapore have taken proactive regulatory steps, doctrinal and procedural uncertainties persist globally. This underscores the pressing need for legal harmonization, cross-border interpretive guidance, and updated trade law instruments. Despite such efforts, key international instruments such as the WTO JSI and Hague Principles have yet to be systematically integrated into blockchain-specific trade regulations or smart contract frameworks.

2.6 Conclusion

This chapter has provided an analytical synopsis of the conceptual underpinnings, practical applications, regulatory frameworks, and theoretical approaches associated with blockchain and cryptocurrency in the realm of international trade law. It has

mapped the current academic and legal discourse, revealing both the potential and limitations of blockchain integration within existing legal systems. While blockchain promises greater transparency, efficiency, and decentralization in global trade, the surrounding legal architecture remains uneven, fragmented, and often reactive.

The review has emphasized key theoretical lenses—decentralization theory, trust theory, and legal pluralism—that illuminate the structural shifts blockchain introduces in cross-border commercial relations. It has also assessed the strengths and limitations of international instruments and regional regulations in adapting to this emerging landscape. Despite growing scholarly interest, the literature remains insufficient to address critical issues such as enforceability, jurisdictional conflicts, and legal interoperability of decentralized systems.

By identifying these gaps, the chapter affirms the urgent need for a future-ready legal framework that aligns with blockchain's technological realities while upholding the foundational values of international trade law. The following chapter builds upon this foundation with a comparative analysis of the regulatory approaches adopted in the European Union, United States, India, and Singapore. These case studies provide a structured basis for evaluating the prospects of regulatory harmonization and legal convergence in the digital trade environment.

CHAPTER 3

LEGAL CHALLENGES IN BLOCKCHAIN AND CRYPTOCURRENCY INTEGRATION IN INTERNATIONAL TRADE

3.1 Introduction

As Chapter 2 highlighted, the concept of blockchain as a 'trustless' system challenges traditional legal frameworks that rely on institutional trust. This section builds on that discussion, particularly the theoretical tension between code-based governance and legal enforceability.

The integration of blockchain and cryptocurrency technologies into the landscape of international trade signifies a paradigm shift that offers both transformative opportunities and formidable legal challenges. These technologies promise to revolutionize global commerce by automating contractual execution, enhancing transparency, and lowering transaction costs by eliminating the need for middlemen and settlement times. Through decentralized ledgers and smart contracts, blockchain can digitize and streamline critical trade processes such as shipping documentation, customs clearance, and cross-border payments.[777879]

However, this very decentralization—heralded as a breakthrough in creating trustless systems—also disrupts the foundational assumptions of contract law, jurisdiction, regulatory oversight, and dispute resolution, all of which are traditionally rooted in state-based legal frameworks. These disruptions give rise to significant doctrinal and enforcement dilemmas, especially in cross-border contexts where legal systems diverge sharply in their recognition, classification, and treatment of digital assets and code-

[77] Kevin Werbach, *The Blockchain and the New Architecture of Trust* 11–29 (MIT Press 2018).
[78] Emmanuelle Ganne, *Can Blockchain Revolutionize International Trade?*, WTO Staff Working Paper ERSD-2018-10, at 5–8 (2018), https://www.wto.org/english/res_e/booksp_e/blockchainrev18_e.pdf (last visited March 28, 2025).
[79] World Economic Forum, *Redesigning Trust: Blockchain Deployment Toolkit*, at 8–15 (2020), https://widgets.weforum.org/blockchain-toolkit/pdf/WEF_Redesigning_Trust_Blockchain_Deployment%20Toolkit.pdf.

based agreements.[808182]

The first major challenge lies in regulatory fragmentation: countries have adopted divergent approaches to blockchain governance, resulting in an inconsistent and, at times, conflicting global legal environment. Some jurisdictions have embraced crypto innovation with robust licensing regimes and legal clarity (e.g., the EU under MiCA, and Singapore under the Payment Services Act)[83], while others have imposed restrictive policies or outright bans (e.g., China and Nigeria).[84] This lack of harmonization poses a barrier to legal certainty and contract enforceability in cross-border transactions.

A second critical issue pertains to the enforceability of smart contracts. While these automated digital agreements can increase efficiency and remove ambiguity from trade processes, they often lack the nuanced language, context, and interpretive flexibility needed in traditional legal contracts.[85] Courts may struggle to apply conventional legal doctrines—such as offer and acceptance, mistake, and force majeure—to agreements executed entirely in code.[86] Additionally, civil law and common law systems vary in their recognition of digital consent, further complicating their application in international commerce.[87]

Third, the decentralized and borderless nature of blockchain networks complicates the application of private international law principles, especially those relating to choice of law, jurisdiction, and dispute resolution forums.[88] Traditional doctrines, such as *lex loci*

[80] Kevin Werbach, *The Blockchain and the New Architecture of Trust* 53–79 (MIT Press 2018).
[81] Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* 61–88 (Harvard Univ. Press 2018).
[82] U.N. Comm'n on Int'l Trade Law, *UNCITRAL Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited March 28, 2025).

[83] Regulation (EU) 2023/1114 of the European Parliament and of the Council of 31 May 2023 on Markets in Crypto-assets (MiCA), 2023 O.J. (L 150); Payment Services Act 2019, No. 2 of 2019 (Singapore).
[84] People's Bank of China, *Notice on Further Preventing and Disposing of the Risk of Speculation in Virtual Currency Transactions* (Sept. 24, 2021), https://www.loc.gov/item/global-legal-monitor/2021-10-13/china-central-bank-issues-new-regulatory-document-on-cryptocurrency-trading/; Cent. Bank of Nig., Letter on Cryptocurrency Operations in Nigerian Banks (Feb. 5, 2021), https://www.cbn.gov.ng/out/2021/ccd/letter%20on%20crypto.pdf.
[85] Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* 61–68 (Harvard Univ. Press 2018).
[86] Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 Duke L.J. 313, 320–36 (2017); Max Raskin, *The Law and Legality of Smart Contracts*, 1 Geo. L. Tech. Rev. 305, 307–11 (2017).
[87] U.K. Jurisdiction Taskforce, *Legal Statement on the Status of Cryptoassets and Smart Contracts* 10–11 (2019), https://technation.io/wp-content/uploads/2019/11/6.6056_JO_Cryptocurrencies_Statement_FINAL_WEB_111119-1.pdf.
[88] Kevin Werbach, *The Blockchain and the New Architecture of Trust* 137–45 (MIT Press 2018).

contractus (law of the place where the contract is made) or *forum conveniens* (appropriate forum for litigation), become difficult to apply when parties transact through pseudonymous blockchain addresses, and when contractual performance is distributed across nodes in multiple legal territories.[8990]

Fourth, blockchain-based transactions, particularly those involving cryptocurrencies, pose serious challenges for compliance with anti-money laundering (AML) and know-your-customer (KYC) regulations.[91] Decentralized platforms, anonymity-enhancing features, and the use of stablecoins or privacy coins can circumvent traditional compliance mechanisms.[92] Although international bodies like the Financial Action Task Force (FATF) have extended AML standards to Virtual Asset Service Providers (VASPs)[93], the fragmented enforcement and varied national implementations create loopholes for illicit activity and regulatory arbitrage.

Lastly, the lack of robust dispute resolution mechanisms tailored to blockchain-based commerce remains a significant legal gap.[94] While some have proposed on-chain arbitration systems or algorithmic dispute resolution models[95], these alternatives raise concerns about due process, fairness, and the absence of coercive enforcement powers.[96] Moreover, mainstream courts and arbitration tribunals may lack the technical expertise to interpret and adjudicate disputes arising from smart contract execution.[97]

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[89] Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* 69–75 (Harvard Univ. Press 2018).
[90] U.N. Comm'n on Int'l Trade Law, *UNCITRAL Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited March 28, 2025).
[91] Fin. Action Task Force [FATF], *Updated Guidance for a Risk-Based Approach to Virtual Assets and VASPs* ¶¶ 22–24 (Oct. 2021), https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Updated-Guidance-VA-VASP.pdf.coredownload.inline.pdf (last visited March 28, 2025).
[92] IMF & Financial Stability Board, *IMF-FSB Synthesis Paper*: *Policies for Crypto-Assets,* at 13–17 (Sept. 2023), https://www.fsb.org/uploads/R070923-1.pdf (last visited March 28, 2025).
[93] Financial Action Task Force (FATF), *Updated Guidance for a Risk-Based Approach to Virtual Assets and VASPs,* ¶¶ 46–59 (Oct. 2021), https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Updated-Guidance-VA-VASP.pdf.coredownload.inline.pdf (last visited March 28, 2025).
[94] Kevin Werbach, *The Blockchain and the New Architecture of Trust* 153–60 (MIT Press 2018).
[95] U U.N. Comm'n on Int'l Trade Law, *UNCITRAL Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited March 28, 2025).
[96] Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* 103–108 (Harvard Univ. Press 2018).
[97] U.K. Jurisdiction Taskforce, *Legal Statement on the Status of Cryptoassets and Smart Contracts* 16–17 (2019), https://technation.io/wp-content/uploads/2019/11/6.6056_JO_Cryptocurrencies_Statement_FINAL_WEB_111119-1.pdf.

In summary, while blockchain and cryptocurrencies offer immense potential to redefine international trade, their success hinges on the development of coherent, interoperable, and adaptive legal frameworks. This chapter examines the above challenges through a doctrinal and comparative legal lens, identifying not only gaps in current laws but also opportunities for harmonization and reform. The analysis builds upon the theoretical insights from the previous chapters—particularly legal pluralism and decentralization theory—to assess whether legal norms are evolving in pace with technological disruption or lagging behind in ways that hinder innovation.

3.2 Regulatory Fragmentation and Legal Pluralism

This regulatory fragmentation not only complicates legal compliance but also directly feeds into broader challenges regarding the enforceability of digital agreements, which will be the focus of the following section.

One of the most significant obstacles to integrating blockchain and cryptocurrency technologies into international trade law is the divergent regulatory landscape across jurisdictions. While blockchain inherently functions as a decentralized and borderless technology, the legal systems it interacts with are based on sovereignty, territoriality, and national legal traditions. This fundamental mismatch creates considerable uncertainty for commercial actors, especially in cross-border operations.[98]

Digital assets are categorized differently depending on the jurisdiction—ranging from property and securities to currencies, commodities, or uniquely defined digital forms. Each classification carries with it a set of legal consequences, impacting tax treatment, trading rights, consumer protections, and contract enforceability. In the United States, for instance, the SEC considers many crypto-assets to be "investment contracts" under the Howey test, thereby falling within federal securities law.[99] Meanwhile, the CFTC treats cryptocurrencies as commodities in the context of futures and derivatives,[100] and

[98] Alesia Zhuk, *Beyond the Blockchain Hype: Addressing Legal and Regulatory Challenges*, 5 SN Soc. Sci. 10, 1–17 (2025), file:///C:/Users/acer/Downloads/s43545-024-01044-y.pdf.
[99] U.S. Sec. & Exch. Comm'n, *Report of Investigation Pursuant to Section 21(a) of the Securities Exchange Act of 1934: The DAO* (2017), https://www.sec.gov/litigation/investreport/34-81207.pdf.
[100] In re Coinflip, Inc., CFTC No. 15-29, 2015 WL 5535736 (Sept. 17, 2015).

FinCEN regulates them as a form of "value" under its anti-money laundering rules for money services businesses.[101]

In contrast, the European Union has adopted a more unified and proactive approach through the Markets in Crypto-Assets (MiCA) Regulation, finalized in 2023. MiCA establishes a coherent classification system—including asset-referenced tokens, e-money tokens, and utility tokens—and introduces standardized licensing, transparency, and consumer protection measures applicable across all EU member states.[102] This harmonized legal architecture aims to reduce regulatory uncertainty while supporting innovation and legal coherence in digital finance.

The lack of alignment between national regulations becomes particularly problematic in the context of international transactions. A smart contract deemed valid and enforceable in one legal regime may be considered void or even unlawful under another, due to differing rules on digital assets or automated agreements.[103] This disparity erodes commercial trust, complicates legal due diligence, and discourages businesses from utilizing blockchain for cross-border payments and contractual arrangements.[104]

Such inconsistencies also strike at the heart of legal certainty—an essential principle in commercial law. Without a shared set of definitions or coordinated enforcement protocols, international companies must often allocate substantial resources toward jurisdiction-specific compliance reviews, a burden especially felt by smaller enterprises with limited legal infrastructure.[105]

The concept of legal pluralism becomes highly relevant in this context. Legal pluralism recognizes the simultaneous existence of multiple normative systems—ranging from formal state law to transnational frameworks, private contractual arrangements, and

[101] Fin. Crimes Enf't Network (FinCEN), *Application of FinCEN's Regulations to Certain Business Models Involving Convertible Virtual Currencies* 2–5 (May 9, 2019), https://www.fincen.gov/sites/default/files/2019-05/FinCEN%20Guidance%20CVC%20FINAL%20508.pdf.
[102] Regulation (EU) 2023/1114 of the European Parliament and of the Council on Markets in Crypto-assets (MiCA), OJ L 150, 9.6.2023, p. 40–94.
[103] Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 Duke L.J. 313, 333–37 (2017).
[104] Aaron Wright & Primavera De Filippi, *Decentralized Blockchain Technology and the Rise of Lex Cryptographia,* (2015), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2580664.
[105] IMF & Financial Stability Board, *IMF-FSB Synthesis Paper*: *Policies for Crypto-Assets,* at 17–19 (Sept. 2023), https://www.fsb.org/uploads/R070923-1.pdf (last visited March 28, 2025).

community-based norms.[106] Within blockchain ecosystems, this pluralism is reflected in the rise of so-called lex cryptographia, where code and algorithmic protocols function as self-executing legal systems.[107]

Despite its theoretical appeal, legal pluralism introduces practical complications.[108] The existence of multiple, overlapping legal systems—each with distinct rules, enforcement practices, and definitions—makes cross-border legal interoperability exceedingly difficult.[109] Courts and regulators often lack the expertise to interpret blockchain-driven transactions, especially when such dealings transcend traditional geographic and jurisdictional boundaries.[110]

This fragmentation impacts not only contract recognition and asset classification but also dispute resolution—the pillars of international trade law. For example, a blockchain-executed trade contract involving cryptocurrency payments may face enforceability challenges if the underlying digital asset is not acknowledged as valid consideration under a given jurisdiction's contract law.[111] Likewise, courts may be reluctant to recognize smart contracts or blockchain records as valid evidence, particularly when faced with self-executing code that lacks human-readable interpretation.[112]

Ultimately, while the presence of diverse legal systems reflects the sovereignty of individual states, it also underscores a lack of cohesive governance in the global digital economy.[113] The absence of consensus on core legal questions—such as the legal status of digital assets, the meaning of consent in coded contracts, or the identification of appropriate legal forums—poses a major obstacle to blockchain's seamless adoption in

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[106] Brian Z. Tamanaha, *Understanding Legal Pluralism: Past to Present, Local to Global*, 30 Sydney L. Rev. 375 (2008).
[107] Lawrence Lessig, *Code and Other Laws of Cyberspace* (2d ed. 2006).
[108] Brian Z. Tamanaha, *Understanding Legal Pluralism: Past to Present, Local to Global*, 30 Sydney L. Rev. 387-90 (2008).
[109] U.N. Comm'n on Int'l Trade Law, *UNCITRAL Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited March 28, 2025).
[110] U.K. Jurisdiction Taskforce, *Legal Statement on the Status of Cryptoassets and Smart Contracts* 16–17 (2019), https://technation.io/wp-content/uploads/2019/11/6.6056_JO_Cryptocurrencies_Statement_FINAL_WEB_111119-1.pdf.
[111] Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 Duke L.J. 313, 359–60 (2017).
[112] Max Raskin, *The Law and Legality of Smart Contracts*, 1 Geo. L. Tech. Rev. 305, 307–09 (2017).
[113] Emmanuelle Ganne, *Can Blockchain Revolutionize International Trade?*, WTO Staff Working Paper ERSD-2018-10, at 12–15 (2018), https://www.wto.org/english/res_e/booksp_e/blockchainrev18_e.pdf (last visited March 28, 2025).

international trade.[114] Without greater international coordination—whether through UNCITRAL model laws, bilateral legal agreements, or industry-led protocols—the full promise of blockchain in global commerce will continue to be limited by jurisdictional fragmentation.[115]

3.3 Enforceability of Smart Contracts in Cross-Border Trade

India, as an example, has not yet established clear statutory provisions specifically recognizing smart contracts.[116] Instead, its legal framework continues to depend on traditional contract law doctrines.[117] However, enforceability issues may arise due to provisions in the Information Technology Act, particularly those concerning the validity of electronic signatures.[118] This section tackles a fundamental issue highlighted in Chapter 2: the extent to which established legal doctrines can evolve to accommodate automated, code-driven agreements.

Smart contracts—essentially self-executing digital protocols embedded within blockchain networks—mark a significant divergence from the conventional understanding of contracts in legal theory.[119] Unlike traditional agreements, which depend on textual articulation and human interpretation, smart contracts are built on automated logic that triggers specific outcomes once certain pre-set conditions are fulfilled.[120] This rigid, deterministic nature facilitates streamlined and efficient transactions, but it also presents substantial issues concerning legal recognition and enforceability, especially within the realm of international commerce.[121]

Conventional contract law evaluates the legitimacy of agreements based on foundational elements such as offer, acceptance, consideration, mutual intent, and legal capacity.[122][123] It also allows room for judicial interpretation of unclear terms,

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[114] Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 Duke L.J. 313, 359–62 (2017).
[115] IMF & Financial Stability Board, *IMF-FSB Synthesis Paper*: *Policies for Crypto-Assets,* at 23–25 (Sept. 2023), https://www.fsb.org/uploads/R070923-1.pdf (last visited March 28, 2025).
[116] NITI Aayog, *Blockchain: The India Strategy – Part 1*, at 24–26 (2020), https://www.niti.gov.in/sites/default/files/2020-01/Blockchain_The_India_Strategy_Part_I.pdf.
[117] Indian Contract Act, 1872, §§ 10–13 (governing offer, acceptance, consideration, and intention to create legal relations).
[118] Information Technology Act, 2000, § 3A (India) (regarding electronic signatures and legal validity).
[119] Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 Duke L.J. 313, 316–18 (2017).
[120] Max Raskin, *The Law and Legality of Smart Contracts*, 1 Geo. L. Tech. Rev. 305, 307–10 (2017).
[121] Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* 61–75 (Harvard Univ. Press 2018).
[122] Indian Contract Act, No. 9 of 1872, §§ 10–13 (India).
[123] Restatement (Second) of Contracts §§ 17–24 (Am. L. Inst. 1981).

consideration of equitable defenses like mistake or coercion, and application of remedies tailored to justice.[124] In stark contrast, smart contracts operate exclusively through code—a medium that lacks interpretive flexibility and cannot adjust for unforeseen developments or inequitable consequences.[125] Once the conditions embedded in the code are satisfied, the contract executes automatically, leaving no opportunity to intervene or modify outcomes in response to errors or altered circumstances.[126]

The concept often referred to as "code is law," originally proposed by Lawrence Lessig, encapsulates the normative idea that algorithmically enforced rules have the potential to replace conventional legal institutions.[127] However, from a legal doctrinal perspective, this replacement prompts critical inquiry into whether essential elements such as intent, consent, and mutual agreement can truly be derived from machine-executable language—especially when the parties involved may lack a comprehensive understanding of the code's technical ramifications.

This issue becomes even more complex in the realm of cross-border commerce, where legal systems diverge not just in procedural rules and evidentiary requirements, but also in their foundational approaches to contract theory. For example, common law countries like the United Kingdom, the United States, and India typically stress the importance of consideration and the parties' internal intent.[128] In contrast, civil law jurisdictions such as Germany, France, and Japan prioritize the outward expression of will, placing less emphasis on subjective intent and more on how agreement is objectively demonstrated.[129] Such doctrinal disparities can lead to inconsistent treatment of smart contracts, especially in cases where the contracting parties operate under differing legal traditions.[130]

Certain legal systems have started to engage with these emerging challenges. In 2019, the UK Jurisdiction Taskforce (UKJT) issued a legal statement affirming that smart contracts can fulfill the criteria of a valid contract under English law, as long as the

[124] Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 Duke L.J. 313, 344–50 (2017).
[125] Max Raskin, *The Law and Legality of Smart Contracts*, 1 Geo. L. Tech. Rev. 305, 308–11 (2017).
[126] Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* 67–73 (Harvard Univ. Press 2018).
[127] Lawrence Lessig, *Code: And Other Laws of Cyberspace* 5–6 (1999).
[128] E. Allan Farnsworth, *Contracts* 98–105 (4th ed. 2004).
[129] Boris Kozolchyk, *Comparative Commercial Contracts: Law, Practice and Culture* 128–35 (2014).
[130] Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 Duke L.J. 313, 359–63 (2017).

essential contractual elements are present. The statement clarified that, despite being expressed in code, smart contracts could still demonstrate intent and consent through surrounding evidence—such as user interfaces, email communications, and supplementary agreements.[131] Likewise, regulatory bodies in Singapore—namely the Infocomm Media Development Authority (IMDA)[132] and the Monetary Authority of Singapore (MAS)[133]—have embraced a technology-neutral stance, acknowledging smart contracts as part of the broader framework governing electronic agreements and digital commerce.[134]

Nevertheless, these developments remain confined to specific jurisdictions and fall short of establishing a unified global standard. As a result, international commercial entities face ongoing uncertainty regarding the cross-border enforceability of smart contracts. This ambiguity extends to key legal dimensions such as applicable law, jurisdictional authority, and mechanisms for resolving disputes—all of which are foundational to the stability of global trade. In the event of a conflict—whether stemming from non-performance, misinterpretation, or flaws in the code—critical questions arise: Can the code itself function as admissible evidence? How will courts interpret agreements that lack conventional language? And what legal remedies, if any, are available once a blockchain transaction has already been irreversibly executed?[135]

Another pressing issue relates to the evidentiary treatment of smart contracts. Although blockchain technology offers immutable and transparent records, many legal systems continue to rely on traditional evidentiary norms that prioritize paper-based or textually explicit documentation. In the absence of a natural language counterpart or clearly articulated contractual terms, parties to a dispute may struggle to demonstrate the agreement's intent, scope, or the occurrence of a breach in a manner that courts can

[131] U.K. Jurisdiction Taskforce, *Legal Statement on the Status of Cryptoassets and Smart Contracts* 10–11 (2019), https://technation.io/wp-content/uploads/2019/11/6.6056_JO_Cryptocurrencies_Statement_FINAL_WEB_111119-1.pdf.
[132] Infocomm Media Dev. Auth. (IMDA), Trusted Data Sharing Framework (2020), https://www.imda.gov.sg/-/media/imda/files/programme/ai-data-innovation/trusted-data-sharing-framework.pdf.
[133] Monetary Auth. of Sing., *FinTech Regulatory Sandbox Guidelines* (Jan. 1, 2022), https://www.mas.gov.sg/-/media/mas-media-library/development/regulatory-sandbox/sandbox/fintech-regulatory-sandbox-guidelines-jan-2022.pdf (last visited April 02, 2025).
[134] Chambers & Partners, *Blockchain 2024: Singapore Law & Practice* § 2.1 (2024), https://practiceguides.chambers.com/practice-guides/blockchain-2024/singapore.
[135] Alesia Zhuk, *Beyond the Blockchain Hype: Addressing Legal and Regulatory Challenges*, 5 SN Soc. Sci. 10, (2025), file:///C:/Users/acer/Downloads/s43545-024-01044-y.pdf.

readily interpret.[136] This challenge becomes even more critical in the context of high-value, cross-border transactions, where the financial stakes are substantial and there is little tolerance for interpretive ambiguity or legal uncertainty.[137]

Additionally, smart contracts are frequently integrated within decentralized applications (dApps) or Decentralized Autonomous Organizations (DAOs), which complicates fundamental legal concepts such as party identification, agency, and contractual capacity.[138] When a DAO protocol activates a smart contract, identifying the responsible legal counterparty becomes a complex issue.[139] Similarly, courts face difficulties in assigning liability when the underlying code is collaboratively developed and deployed by pseudonymous contributors operating across multiple jurisdictions.[140] Traditional contract law provides limited tools for navigating these novel scenarios, particularly in the context of international commercial dealings.[141]

To conclude, while smart contracts offer remarkable potential for streamlining international trade—enhancing efficiency in areas like payment processing, supply chain logistics, and trade finance—their legal enforceability remains inconsistent and unresolved across jurisdictions.[142] Moving forward, courts and regulatory bodies will need to adopt innovative interpretive approaches and adapt legal doctrines, possibly through frameworks such as UNCITRAL Model Law on Automated Contracting (2024), standardized industry practices, and technical accreditation systems.[143] Without such integration, smart contracts may continue to deliver technological benefits while remaining legally precarious, limiting their utility in the highly regulated landscape of

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[136] *Id*
[137] G. Garriga Suau, *Blockchain-Based Smart Contracts and Conflict Rules for Business-to-Business Operations*, Rev. Electrónica de Estud. Int'l (2021), file:///C:/Users/acer/Downloads/Dialnet-BlockchainbasedSmartContractsAndConflictRulesForBu-7983239%20(1).pdf.
[138] Aaron Wright & Primavera De Filippi, *Decentralized Blockchain Technology and the Rise of Lex Cryptographia,* (2015), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2580664.
[139] U.K. Jurisdiction Taskforce, *Legal Statement on Cryptoassets and Smart Contracts* (2019), at 15–16, https://technation.io/wp-content/uploads/2019/11/6.6056_JO_Cryptocurrencies_Statement_FINAL_WEB_111119-1.pdf.
[140] Kevin Werbach, *The Blockchain and the New Architecture of Trust* 153–160 (MIT Press 2018).
[141] Max Raskin, *The Law and Legality of Smart Contracts*, 1 Geo. L. Tech. Rev. 305, 310–13 (2017).
[142] Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 Duke L.J. 313, 359–62 (2017); G. Garriga Suau, *Blockchain-Based Smart Contracts and Conflict Rules for Business-to-Business Operations*, Rev. Electrónica de Estud. Int'l (2021), file:///C:/Users/acer/Downloads/Dialnet-BlockchainbasedSmartContractsAndConflictRulesForBu-7983239%20(1).pdf.
[143] U.N. Comm'n on Int'l Trade Law, *UNCITRAL Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited April 02, 2025).

global commerce.[144] Without such integration and harmonization, smart contracts may continue to deliver technological benefits while remaining legally precarious—undermining trust, inhibiting enforcement, and limiting their true potential in global trade.

3.4 Jurisdictional Complexities and Conflict of Laws

Among the most significant legal disruptions posed by blockchain technology is its challenge to established doctrines of territorial jurisdiction and conflict of laws. Traditional private international law relies heavily on geographically defined criteria—such as the location where a contract is formed (*lex loci contractus*), the place of its performance (*lex loci solutionis*), or the domicile or habitual residence of the contracting parties. These foundational concepts guide the determination of applicable law, jurisdictional competence, and the appropriate forum for resolving disputes in transnational legal contexts.[145] Yet, transactions conducted via blockchain fundamentally disrupt these spatial assumptions, as they are not anchored to any single geographic location.

Smart contracts and cryptocurrency transactions are carried out over decentralized ledgers, with execution occurring simultaneously across numerous nodes worldwide rather than within a fixed territorial boundary. Participants often engage through pseudonymous digital wallets, lacking identifiable physical locations, national affiliations, or even recognized legal identities. As a result, the lack of a definitive situs or jurisdictional anchor challenges the traditional application of conflict-of-law rules and threatens the consistency of existing frameworks for resolving cross-border legal disputes.[146]

This lack of clear jurisdictional anchoring gives rise to a host of intricate legal questions. For instance, how can one determine the place of contract formation when both parties transact through anonymous wallet addresses? Which legal system applies

[144] Alesia Zhuk, *Beyond the Blockchain Hype: Addressing Legal and Regulatory Challenges*, 5 SN Soc. Sci. 10 (2025), file:///C:/Users/acer/Downloads/s43545-024-01044-y.pdf.
[145] Symeon C. Symeonides, *Choice of Law in the American Courts in 2020: Thirty-Fourth Annual Survey*, 69 Am. J. Comp. L. 1, 8–12 (2021).
[146] Georgina Garriga Suau, *Blockchain-Based Smart Contracts and Conflict Rules for Business-to-Business Operations*, Rev. Electrónica de Estud. Int'l, No. 41, at 12 (2021), file:///C:/Users/acer/Downloads/Dialnet-BlockchainbasedSmartContractsAndConflictRulesForBu-7983239%20(1).pdf.

when the transaction is executed across a globally dispersed network of nodes? Moreover, how can a national court claim jurisdiction or enforce a judgment when the parties involved may be unidentifiable, unreachable, or lack a recognized legal persona?

The complexity deepens when multiple parties from different legal jurisdictions are engaged—for example, in global supply chains coordinated through blockchain platforms or in cross-border transactions settled with cryptocurrencies. In these cases, courts may be confronted with competing or contradictory assertions of jurisdiction. Disputes may also arise over which legal framework applies, particularly when the smart contract exists solely in code and lacks a written version specifying the governing law or detailing a dispute resolution mechanism.[147]

Although certain smart contracts seek to reduce legal ambiguity by incorporating forum selection and choice-of-law clauses, these safeguards may lose their effectiveness within a blockchain environment. Courts might decline to uphold such provisions if they are embedded in code that the contracting parties did not fully understand or if essential procedural standards for valid jurisdictional consent are not satisfied. Moreover, the automatic execution of obligations through code may circumvent critical requirements under domestic contract formation laws, thereby introducing additional barriers to enforceability.[148]

Arbitration also encounters parallel uncertainties in the context of smart contracts. Although arbitral bodies typically uphold party autonomy in choosing the seat of arbitration and governing law, disputes arising from smart contracts frequently lack explicit arbitration clauses and often involve parties whose legal identities are unclear or undefined. For example, Decentralized Autonomous Organizations (DAOs), which are increasingly instrumental in deploying smart contracts, often operate without formal legal recognition in many jurisdictions. This absence of legal personality raises complex issues regarding their capacity to participate in arbitration or be held accountable under arbitral awards.[149]

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[147] Ghassan Adhab Atiyah, Ahmed Ismael Ibrahim & Ahmed Abdulkhudhur Jasim, Enforcement of Smart Contracts in Cross-Jurisdictional Transactions, *Int'l J.L. & Mgmt.* (Dec. 2024), https://www.researchgate.net/publication/387176520_Enforcement_of_smart_contracts_in_cross-jurisdictional_transactions.

[148] Max Raskin, *The Law and Legality of Smart Contracts*, 1 Geo. L. Tech. Rev. 305, 315–18 (2017).

[149] Carla Reyes, *DAO Operating Systems: The DAO as a Form of the Firm*, 88 Fordham L. Rev. 447, 456–58 (2019).

The 1958 New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards mandates that arbitration agreements be "in writing" and "signed" by the parties—criteria that can be challenging to meet when agreements are formed exclusively through code. While some courts have interpreted "writing" broadly to encompass digital formats, a blockchain-based contract lacking clear, natural language expression of consent may still fail to meet enforceability thresholds under many national legal frameworks.[150]

To address these legal uncertainties, some scholars have advocated for the creation of jurisdictional frameworks tailored specifically to blockchain environments. Proposed innovations include:

- Decentralized dispute resolution mechanisms like Kleros or Jur, which rely on crowdsourced juries or algorithmic systems to resolve conflicts;
- Statutory default rules that determine applicable law based on factors such as the location of token issuance or the concentration of blockchain nodes;
- The introduction of "digital domiciles," allowing parties to associate their blockchain identities with a designated legal jurisdiction through formal registration.[151]

Nonetheless, these proposed solutions remain largely experimental and have yet to gain formal acceptance within national or international legal systems. The continued absence of standardized jurisdictional principles for blockchain-based transactions presents a significant threat to legal predictability, the accessibility of remedies, and the enforceability of rights in the global commercial arena.

In closing, unless current private international law frameworks are restructured to accommodate the decentralized architecture of blockchain technology, parties engaged in cross-border dealings will remain exposed to considerable legal ambiguity. Future reform—whether led by the Hague Conference on Private International Law[152],

[150] Convention on the Recognition and Enforcement of Foreign Arbitral Awards art. II(1), June 10, 1958, 330 U.N.T.S. 3.
[151] Thibault Schrepel & Vitalik Buterin, *Blockchain Code as Antitrust Law*, 64 Antitrust Bull. 447, 474–80 (2019), file:///C:/Users/acer/Downloads/ssrn-3597399.pdf.
[152] Hague Conf. on Priv. Int'l L., Jurisdiction Project: Towards the Development of a New Legal Instrument, https://www.hcch.net/en/projects/legislative-projects/jurisdiction (last visited April 02, 2025).

UNCITRAL[153], or regional cooperation initiatives—must directly confront the challenge of determining jurisdiction and applicable law within a borderless, automated digital landscape. Without such legal adaptation, the reliability of blockchain as a foundation for international trade may be fundamentally compromised.

3.5 Regulatory Compliance and AML-KYC Obligations

Although anti-money laundering (AML) and know-your-customer (KYC) regulations traditionally fall within the realm of public law, their substantial influence on contract enforceability and trade transparency warrants their discussion in this context.

Blockchain technology is frequently praised for its inherent features—transparency, immutability, and auditability. However, it simultaneously enables pseudonymous transactions, which pose significant compliance challenges, particularly in meeting AML and KYC obligations.[154] This tension between visibility and user anonymity is central to ongoing discussions among regulators, policymakers, and stakeholders in international trade about how blockchain-based financial ecosystems should be governed.[155]

In contrast to conventional financial infrastructures—where identity verification is handled by centralized entities like banks or clearing systems—blockchain networks facilitate direct peer-to-peer interactions without necessarily disclosing the identities of participants. Although public blockchains such as Bitcoin and Ethereum offer transparent transaction logs, the parties are only identifiable by cryptographic addresses, not personal identifiers. The problem is further intensified on privacy-oriented networks like Monero or Zcash, which offer features that obscure transactional details entirely. These anonymity-enhancing mechanisms raise red flags in the context of cross-border trade, particularly with regard to potential misuse for illicit activities such as money

[153] U.N. Comm'n on Int'l Trade Law, Legal Issues Related to the Use of Distributed Ledger Technology in Trade: Scoping Paper, U.N. Doc. A/CN.9/1146 (2023).
[154] Financial Action Task Force (FATF), *Updated Guidance for a Risk-Based Approach to Virtual Assets and VASPs,* 5–8 (Oct. 2021), https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Updated-Guidance-VA-VASP.pdf.coredownload.inline.pdf (last visited April 02, 2025).
[155] Int'l Monetary Fund, Global Financial Stability Report: COVID-19, Crypto, and Climate: Navigating Challenging Transitions, ch. 2, at 47–49 (Oct. 2021), file:///C:/Users/acer/Downloads/text%20(1).pdf.

laundering, terrorist financing, tax evasion, or violations of international sanctions.[156]

In response to these emerging risks, the Financial Action Task Force (FATF)—the global standard-setting body for anti-money laundering efforts—has released detailed guidelines aimed at regulating the virtual asset landscape. In its 2019 guidance, reinforced by a 2021 update, FATF broadened the scope of what constitutes a Virtual Asset Service Provider (VASP). This expanded definition encompasses a wide range of entities, including cryptocurrency exchanges, custodial wallet operators, and other intermediaries involved in the transfer, management, or storage of digital assets.[157] Under the updated FATF guidelines, Virtual Asset Service Providers are obligated to meet several compliance requirements, including:

- Verifying customer identities through customer due diligence (CDD) procedures;
- Establishing systems for ongoing transaction monitoring;
- Detecting and reporting suspicious activity; and
- Adhering to data retention and information-sharing protocols.

One particularly noteworthy provision is the FATF's "Travel Rule," which mandates that VASPs transmit identifying information about both the sender and recipient whenever virtual asset transfers surpass a certain threshold. This requirement parallels similar protocols in traditional banking for wire transfers and is designed to enhance transparency and mitigate illicit use.[158] Although the Travel Rule is intended to bolster traceability and curb unlawful financial activity, its application within decentralized systems has encountered significant legal and technical hurdles. One of the primary challenges stems from the limited jurisdictional authority of national regulators. Platforms such as decentralized exchanges (DEXs), peer-to-peer networks, and non-custodial wallet services typically function without a central administrator or fixed geographic presence, making them difficult for any one jurisdiction to regulate or

[156] Angela Walch, *Deconstructing "Decentralization": Exploring the Core Claim of Crypto Systems in Cryptoassets: Legal, Regulatory, and Monetary Perspectives* 39–65 (Chris Brummer ed., Oxford Univ. Press 2019).
[157] Financial Action Task Force (FATF), *Updated Guidance for a Risk-Based Approach to Virtual Assets and Virtual Asset Service Providers* ¶¶ 46–59 (Oct. 2021), https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Updated-Guidance-VA-VASP.pdf.coredownload.inline.pdf (last visited April 02, 2025).
[158] *Id.*

enforce compliance effectively.[159] Moreover, these decentralized platforms often operate through open-source protocols and community-driven governance models—such as DAOs—making it challenging to pinpoint individuals or entities who can be held legally accountable. This lack of identifiable oversight facilitates regulatory arbitrage, where participants shift their operations to jurisdictions with lax enforcement or unclear legal frameworks concerning digital assets and blockchain activities.

In light of these challenges, some jurisdictions have adopted forward-looking regulatory frameworks to establish clear oversight mechanisms. For instance:

- Singapore's Payment Services Act of 2019 requires providers of digital payment token services to register with the Monetary Authority of Singapore (MAS). These entities must comply with anti-money laundering and counter-terrorism financing (AML/CFT) obligations, including rigorous identity verification processes and mandatory reporting protocols.[160]
- The European Union, via its Fifth and Sixth Anti-Money Laundering Directives (AMLD) and the Markets in Crypto-Assets (MiCA) Regulation, has established harmonized requirements for crypto service providers. These include mandatory user identification procedures and obligations to report potentially suspicious transactions, aiming to create a consistent regulatory environment across member states.[161]
- In South Korea, the Financial Intelligence Unit (KoFIU) mandates that Virtual Asset Service Providers (VASPs) comply with AML regulations by securing partnerships with regulated banks and obtaining certification under the Information Security Management System (ISMS), ensuring robust data security and traceability standards.[162]

In contrast, countries like Nigeria, Russia, and several regions in Latin America continue to struggle with implementing FATF standards due to factors such as

[159] Ross P. Buckley et al., *Regulating Digital Financial Services: Mapping Regulatory Risks and Responses*, 60 Int'l L. 245, 256–58 (2022).
[160] Monetary Auth. of Singapore [MAS], *Guidelines on Provision of Digital Payment Token Services to the Public*, Jan. 2022, https://www.mas.gov.sg/-/media/mas-media-library/regulation/guidelines/pso/ps-g02-guidelines-on-provision-of-digital-payment-token-services-to-the-public/guidelines-on-provision-of-digital-payment-token-services-to-the-public-ps-g02.pdf.
[161] Directive (EU) 2018/843, 2018 O.J. (L 156) 43 (Fifth AMLD); Regulation (EU) 2023/1114 (MiCA).
[162] Financial Action Task Force (FATF), Anti-money Laundering and Counter-terrorist Financing Measures – Korea, 4th Enhanced Follow-up Report 1 (2024), https://www.fatf-gafi.org/content/dam/fatf-gafi/fur/Korea-Follow-Up-Report-2024.pdf.coredownload.inline.pdf.

inadequate technical infrastructure, political hesitancy, and fragmented regulatory systems. These disparities contribute to an uneven global AML compliance landscape, particularly problematic for international trade transactions that utilize cryptocurrency for settlement.

Complicating matters further are the privacy-enhancing features integrated into certain blockchain protocols. Tools such as mixers and tumblers—which obscure transaction trails—can serve legitimate privacy interests but are also frequently exploited for illicit purposes. A notable example occurred in 2022, when the U.S. Treasury's Office of Foreign Assets Control (OFAC) imposed sanctions on the Tornado Cash protocol, alleging its involvement in laundering over $7 billion in unlawful funds, including transactions linked to sanctioned entities.[163] This enforcement action sparked significant debate over the potential legal responsibility of open-source developers and the broader implications of applying U.S. law to decentralized, globally distributed systems.

At the institutional level, organizations like the International Monetary Fund (IMF) and the World Bank have expressed concern over the unregulated adoption of cryptocurrencies in cross-border trade, warning that such practices may undermine financial integrity, disrupt sovereign control over monetary policy, and pose broader risks to macroeconomic stability.[164] In its 2023 Delhi Declaration, the G20 endorsed a joint roadmap developed by the IMF, FATF, and the Financial Stability Board (FSB), highlighting the urgent need for globally coordinated regulatory standards to govern virtual asset transactions.[165]

In summary, although blockchain technology offers advanced mechanisms for transparency and traceability, these advantages are often compromised by gaps in legal frameworks and institutional capacity, particularly concerning AML/KYC enforcement in decentralized or stateless environments. Participants in international trade who utilize crypto-based systems must contend with a fragmented and rapidly evolving regulatory landscape that differs widely from one jurisdiction to another. To promote both legal certainty and technological progress, there is a critical need for harmonized compliance

[163] U.S. Dep't of the Treasury, *Treasury Sanctions Notorious Virtual Currency Mixer Tornado Cash*, Press Release, Aug. 8, 2022, https://home.treasury.gov/news/press-releases/jy0916.
[164] Tobias Adrian & Tommaso Mancini-Griffoli, The Rise of Digital Money, IMF Fin. & Dev. Mag., Dec. 2019, at 3, file:///C:/Users/acer/Downloads/FTNEA2019001%20(1).pdf.
[165] G20, Leaders' Declaration: G20 New Delhi Summit 2023 ¶ 58 (Sept. 9–10, 2023), https://www.mea.gov.in/Images/CPV/G20-New-Delhi-Leaders-Declaration.pdf (last visited April 02, 2025).

models, unified technical protocols, and coordinated enforcement strategies—ideally facilitated by multilateral organizations such as the FATF, WTO, and UNCITRAL.

3.6 Challenges in Blockchain-Based Dispute Resolution

In brief, without established and recognized adjudicatory mechanisms, blockchain-native dispute resolution remains vulnerable to procedural weaknesses and may prove commercially impractical for addressing trade-related conflicts.

Dispute resolution involving blockchain-based smart contracts poses a significant challenge to conventional legal frameworks. These agreements, driven by automated code rather than traditional textual language, present interpretive difficulties—particularly when they lack accompanying legal clauses, written documentation, or clearly defined legal parties. This issue is magnified in the context of international trade, where disputes frequently involve cross-border dynamics and necessitate strong procedural protections, transnational enforceability, and access to equitable outcomes.

Traditional court systems are generally not well-prepared to adjudicate or enforce contracts that are constructed in programming languages rather than natural language. Smart contracts often rely on coding languages like Solidity or Vyper, which can be difficult for both legal professionals and judges to interpret accurately, thereby raising barriers to fair and effective resolution.[166] In these scenarios, courts may encounter significant difficulties in assessing whether valid consent was given, whether a mutual understanding existed, or whether a legally cognizable obligation was formed. Traditional contract doctrines—such as frustration, mistake, or equitable rescission—often rely on interpretive flexibility, which is largely absent in the rigid, deterministic framework of code-based agreements that cannot adapt to ambiguity or unforeseen developments.

Adding to the complexity is the current lack of judicial precedent and procedural consistency in handling smart contract disputes. Although certain jurisdictions, such as England, have made preliminary efforts to define the legal standing of crypto-assets and smart contracts, the number of cases involving purely code-executed agreements remains limited. Consequently, few legal systems have developed clear methodologies

[166] Max Raskin, *The Law and Legality of Smart Contracts*, 1 Geo. L. Tech. Rev. 305, 315–17 (2017).

or best practices for interpreting such contracts in a courtroom setting.[167] In the absence of clear legal guidance, both disputing parties and adjudicators face considerable uncertainty about which legal doctrines apply and how blockchain-based transactions should be evaluated as evidence.

In response to these challenges, both legal scholars and technology developers have proposed innovative arbitration models that integrate directly with blockchain infrastructure. Among these are Decentralized Dispute Resolution (DDR) systems, such as Kleros, Jur, and Aragon Court, which utilize mechanisms like crowdsourced juries, incentive-driven game theory, or algorithmic arbitration protocols embedded within smart contracts to adjudicate disputes in a decentralized environment.[168] These platforms are built to operate autonomously and with a high degree of transparency, aiming to streamline the dispute resolution process by minimizing delays and reducing the costs typically associated with conventional legal proceedings.

Nonetheless, despite their technical sophistication, decentralized dispute resolution (DDR) systems face significant limitations when it comes to legal enforceability. Most lack the authority to compel compliance, fall short of established due process standards, and are not formally recognized within domestic or international legal frameworks. For example, they do not meet the criteria for arbitral institutions under the 1958 New York Convention, which mandates that arbitration agreements be in writing and that resulting awards must not violate the public policy of the state where enforcement is sought.[169]

This limitation greatly reduces the practical viability of blockchain-based arbitration for resolving complex, high-value international trade disputes—particularly where enforcement through national courts is essential. In the absence of formal state recognition or statutory backing, the outcomes of decentralized dispute resolution processes may be ignored by losing parties or dismissed by domestic courts. As a result,

[167] U.K. Jurisdiction Taskforce, *Legal Statement on the Status of Cryptoassets and Smart Contracts* 10–11 (2019), https://technation.io/wp-content/uploads/2019/11/6.6056_JO_Cryptocurrencies_Statement_FINAL_WEB_111119-1.pdf.
[168] Jorge Pesok & Evan Shapiro, *Dispute Resolution in Decentralized Systems: The Kleros Protocol*, 32 Harv. J.L. & Tech. 115, 122–26 (2021).
[169] Convention on the Recognition and Enforcement of Foreign Arbitral Awards art. V, June 10, 1958, 330 U.N.T.S. 3 [hereinafter New York Convention].

these mechanisms often lack the legal force necessary to compel performance, award damages, or issue injunctive remedies.[170]

Certain hybrid frameworks have emerged in an effort to close the gap between decentralized systems and formal legal enforcement. A notable example is the UK Digital Dispute Resolution Rules, introduced by the LawTech Delivery Panel. These rules enable parties to agree in advance to submit disputes related to smart legal contracts to a designated tribunal or technical expert with the capability to interpret both legal language and the underlying code, thereby aligning technological and legal reasoning in dispute resolution.[171] Likewise, leading institutional arbitration bodies such as the LCIA, ICC, and SIAC have shown growing interest in modifying their procedural rules to better address disputes arising from smart contracts. However, the actual implementation of such adaptations remains nascent and largely theoretical at this stage.

The situation is further complicated by the increasing involvement of Decentralized Autonomous Organizations (DAOs) in global commercial activities through the deployment of smart contracts. These entities often lack formal legal status, centralized representation, or predefined dispute resolution frameworks, leading to significant uncertainty over legal standing—particularly in terms of who holds the authority to initiate or respond to legal action in the event of contract breaches or technical malfunctions.[172]

To promote legal certainty and foster confidence in blockchain-enabled commerce, it is essential to establish well-defined procedural rules, standardized arbitration clauses, and judicial guidance for interpreting and enforcing smart contracts. Emerging legal instruments—such as the 2024 UNCITRAL Model Law on Automated Contracting, which has been adopted by UNCITRAL but requires national implementation[173]—

[170] Carla L. Reyes, *Disputing Decentralized Autonomous Organizations*, 88 Fordham L. Rev. 447, 463–65 (2019).
[171] UK Jurisdiction Taskforce, LawtechUK, Digital Dispute Resolution Rules, Version 1.0 (Apr. 2021), https://mattereum.com/wp-content/uploads/docs/UKJT-Digital-Dispute-Resolution-Rules.pdf.
[172] Thibault Schrepel, *Smart Contracts and the Code-ification of Private Law*, 67 Buff. L. Rev. 1029, 1056–60 (2019).
[173] U.N. Comm'n on Int'l Trade Law, *UNCITRAL Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited April 02, 2025).

could serve as foundational tools for developing cohesive regulatory approaches. Nevertheless, without binding multilateral agreements or meaningful domestic legal reform, the adjudication of blockchain-related disputes will remain uncertain, fragmented, and vulnerable to jurisdictional inconsistencies.

3.7 Emerging Need for Harmonization

The cumulative challenges explored in this chapter—from fragmented regulations and doctrinal ambiguity to inconsistencies in enforcement and jurisdictional uncertainty—highlight the pressing need for harmonized legal frameworks at both domestic and international levels. Absent coordinated reforms, the transformative potential of blockchain and cryptocurrencies in the realm of international trade is unlikely to be fully realized, limited by the contradictions and gaps that currently define the legal environment.

Although blockchain technology is inherently transnational, functioning across decentralized networks, the legal systems governing commercial activity remain bound to territorial jurisdictions and are premised on centralized authority and clearly identifiable legal entities. This disconnect between technological infrastructure and regulatory architecture impedes the advancement of blockchain-driven trade mechanisms, exposing parties to legal uncertainty, jurisdictional arbitrage, and enforcement breakdowns. The lack of legal interoperability poses risks not only to private stakeholders, but also to states, financial institutions, and global supply chains that increasingly depend on digital platforms for operational efficiency and resilience.

Some progress has been made in recent years through the development of model laws, notably by international organizations such as UNCITRAL. A key milestone was the adoption of the UNCITRAL Model Law on Electronic Transferable Records (2017), which established the legal equivalence of electronic and paper-based trade documents—setting a crucial precedent for the broader acceptance of digital trade infrastructure.[174] Nevertheless, the 2017 Model Law does not fully address the legal complexities posed by blockchain technology, smart contracts, and tokenized assets within automated commercial ecosystems. To close this regulatory gap, UNCITRAL adopted the Model Law on Automated Contracting in July 2024, providing a

[174] UNCITRAL, *Model Law on Electronic Transferable Records* (2017), U.N. Doc. A/CN.9/902.

comprehensive legal framework for cross-border recognition and enforceability of obligations generated through automated contracting systems. This framework is designed to address legal ambiguities associated with machine-executed transactions, including those facilitated by blockchain protocols, tokenized assets and automated logistics platforms. By proposing standardized rules for the recognition, interpretation, and enforcement of code-based transactions, the Model Law seeks to reconcile traditional legal norms with the decentralized and autonomous nature of emerging trade technologies.[175] It also addresses foundational elements such as digital identity, consent, and the evidentiary status of automated outputs—components essential for ensuring legal certainty and operational resilience in global commerce.

Yet, despite these encouraging advances, substantial gaps remain. Foundational legal instruments in international trade, such as the United Nations Convention on Contracts for the International Sale of Goods (CISG), have not been updated to address the legal implications of digital assets or smart contracts. The CISG continues to rely on classical contract concepts—like offer, acceptance, and the requirement of a written agreement—which can prove difficult to reconcile with the automated execution and pseudonymous nature of blockchain-based transactions.[176] While Article 13 of the CISG permits the use of electronic communications, it does not envision scenarios in which contractual obligations are initiated or fulfilled autonomously by code, without direct human intervention.

Regional legal frameworks—such as the European Union's Digital Services Act[177], the Data Act[178], and the Markets in Crypto-Assets (MiCA) Regulation[179]—mark significant progress toward holistic digital regulation. However, their jurisdictional scope remains confined to EU member states and is shaped by ongoing political negotiations.

[175] U.N. Comm'n on Int'l Trade Law, *UNCITRAL Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited April 07, 2025).
[176] United Nations Convention on Contracts for the International Sale of Goods (CISG), Apr. 11, 1980, 1489 U.N.T.S. 3.
[177] Regulation (EU) 2022/2065 of the European Parliament and of the Council of 19 October 2022 on a Single Market for Digital Services and amending Directive 2000/31/EC (Digital Services Act), 2022 O.J. (L 277) 1.
[178] Regulation (EU) 2023/2854 of the European Parliament and of the Council of 13 December 2023 on harmonised rules on fair access to and use of data and amending Regulation (EU) 2017/2394 and Directive (EU) 2020/1828 (Data Act), 2023 O.J. (L 2854) 1.
[179] Regulation (EU) 2023/1114 of the European Parliament and of the Council of 31 May 2023 on markets in crypto-assets and amending Regulations (EU) No 1093/2010 and (EU) No 1095/2010 and Directives 2013/36/EU and (EU) 2019/1937 (MiCA), 2023 O.J. (L 150) 40.

Comparable limitations are evident in other national initiatives, including Singapore's Payment Services Act[180], Switzerland's FINMA Guidelines[181], and India's proposed Digital India Act. Each of these operates independently and is informed by distinct regulatory approaches, resulting in a fragmented and often inconsistent global landscape for digital governance.

This challenge is further intensified by the divergence between civil law and common law systems, which approach core contract doctrines—such as formation, evidentiary standards, and available remedies—in fundamentally different ways. These legal distinctions influence whether smart contracts are deemed enforceable, whether automated execution is interpreted as valid consent, and whether errors in code can justify equitable relief. In the absence of trans-systemic legal instruments or harmonized interpretive approaches, the inherently decentralized nature of blockchain technology remains at odds with the jurisdictionally fragmented architecture of international law.

As a result, there is an urgent call for international cooperation through multilateral entities such as UNCITRAL, UNIDROIT, the WTO, and the Hague Conference on Private International Law. These bodies are best positioned to develop cross-border legal standards that promote the interoperability, recognition, and enforceability of blockchain-based commercial frameworks.[182] Such standards should encompass:

- Formal recognition of smart contracts as legitimate expressions of contractual intent;
- Legal classification of crypto-assets as valid forms of consideration or payment;
- Clear criteria for establishing digital identity and consent;
- Robust procedures for resolving cross-border disputes involving automated systems.

Ultimately, it is only through synchronized legal reform and institutional convergence that the global trading system can fully harness the transformative capabilities of blockchain, while safeguarding participants from legal ambiguity and transactional

[180] *Payment Services Act 2019*, No. 2 of 2019 (Sing.)
[181] Swiss Financial Market Supervisory Authority (FINMA), *Guidance 02/2019: Payments on the Blockchain* (Aug. 26, 2019), https://www.finma.ch/en/~/media/finma/dokumente/dokumentencenter/myfinma/4dokumentation/finma-aufsichtsmitteilungen/20190826-finma-aufsichtsmitteilung-02-2019.pdf?sc_lang=en&hash=969666F37D318BA81D9A54C10DF94A33.
[182] M.M. Fogt, *Introduction to Private International Law in an Era of Change*, in Private International Law in an Era of Change 1 (M.M. Fogt ed., Edward Elgar 2024).

vulnerabilities. Without such harmonization, blockchain will remain caught in a state of legal limbo—technologically sophisticated, yet precariously situated within an outdated and fragmented legal framework.

3.8 Conclusion

The comparative chapter that follows will examine how various legal systems respond to the multifaceted challenges discussed thus far, while also laying the groundwork for the practical reform models and jurisdiction-specific applications to be explored in Chapters 5 and 6.

Blockchain and cryptocurrency technologies offer transformative potential for increasing transparency, streamlining operations, and automating processes within international trade. Yet, their widespread adoption remains hindered by a disjointed and evolving legal framework. Persistent issues—including regulatory inconsistency, ambiguity surrounding smart contract enforceability, jurisdictional overlaps, and gaps in AML/KYC compliance—continue to erode legal predictability and deter broader commercial engagement.

Addressing these barriers requires a unified, multilateral legal strategy capable of fostering legal interoperability and reinforcing trust in blockchain-based trade mechanisms. As innovation in digital infrastructure advances at a faster pace than legal adaptation, it is imperative for legislators, judicial bodies, and global institutions to pursue harmonization and modernize legal doctrines accordingly.

The next chapter presents a comparative analysis of how leading jurisdictions are confronting these legal challenges. By highlighting best practices and novel policy approaches, it aims to inform future legal reforms that can support the responsible integration of blockchain into the fabric of international commerce.

CHAPTER 4

COMPARATIVE LEGAL APPROACHES TO SMART CONTRACTS AND CRYPTOCURRENCY PAYMENTS IN INTERNATIONAL TRADE

4.1 Introduction and Overview

Blockchain technology and cryptocurrencies promise to revolutionize international trade by streamlining documentation, enhancing supply chain transparency, and enabling fast, secure cross-border payments.[183] *Smart contracts* – self-executing contracts written in computer code on a blockchain – offer a way to automate commercial transactions without intermediaries.[184] However, these innovations also challenge existing legal frameworks. Unlike traditional trade mechanisms, blockchain systems are decentralized and borderless, which creates tension with law's fundamentally jurisdiction-bound nature.[185] There is currently no single harmonized international legal regime for cryptocurrencies or smart contracts in trade; instead, a patchwork of national laws and regulations has emerged.[186] This regulatory fragmentation means that legal treatment of crypto-assets and smart contracts varies widely across jurisdictions – from jurisdictions that are enabling and adaptive, to those that have been restrictive or prohibitive.[187] The result is uncertainty for businesses

[183] Don Tapscott & Alex Tapscott, *Blockchain Revolution: How the Technology Behind Bitcoin Is Changing Money, Business, and the World* 6–7 (Penguin 2016); World Trade Organization, *Can Blockchain Revolutionize International Trade?* 1–3 (2018), https://www.wto.org/english/res_e/booksp_e/blockchainrev18_e.pdf.

[184] Riccardo de Caria, *A Digital Revolution in International Trade? The International Legal Framework for Blockchain Technologies, Virtual Currencies and Smart Contracts: Challenges and Opportunities* 4–5 (UNCITRAL 50th Anniversary Congress, 2017), https://www.scribd.com/document/654666150/Digital-Revolution-in-International-Trade.

[185] UK Jurisdiction Taskforce, *Legal Statement on Cryptoassets and Smart Contracts* 3 (2019), https://technation.io/wp-content/uploads/2019/11/6.6056_JO_Cryptocurrencies_Statement_FINAL_WEB_111119-1.pdf; Emily M. Wechsler, *Jurisdiction in Cyberspace: Blockchain and the Borderless Challenge*, 20 Stan. Tech. L. Rev. 567, 570 (2022).

[186] Joong Woo Seo (J.W. Seok), *Regulation of Crypto Assets in the US, EU, and Korea*, 7(2) Bus. & Fin. L. Rev. 1, 3–4 (2024); Barbara C. Matthews, *The Quest for Coordinated Crypto Regulation*, 58 Int'l Law. 453, 454–55 (2024).

[187] Brittany Custers & Laura Overwater, *Regulating Initial Coin Offerings and Cryptocurrencies: A Comparison of Nine Jurisdictions*, 10(3) Eur. J. L. & Tech. (2019), file:///C:/Users/acer/Downloads/ssrn-3527469.pdf; Aditya Narain & Marina Moretti, Regulating Crypto, Fin. & Dev., Sept. 2022, https://www.imf.org/en/Publications/fandd/issues/2022/09/Regulating-crypto-Narain-Moretti.

engaging in cross-border blockchain-based transactions, as questions of contract enforceability, jurisdiction, and compliance obligations remain unsettled on the international stage.[188] In this chapter, we examine how four key jurisdictions – the United States, the European Union, Singapore, and India – are approaching the legal issues surrounding smart contracts and cryptocurrency payments in the context of international trade. We also note relevant international efforts and comparative insights. All significant factual and legal assertions are documented with Bluebook-compliant footnotes, drawing on primary laws, regulations, case law, and authoritative commentary.

4.2 United States: Existing Frameworks and Emerging Adaptations

Legal Status of Smart Contracts: The United States has not enacted a singular federal law explicitly governing "smart contracts," but their enforceability generally falls under existing contract and electronic commerce laws. Under the federal Electronic Signatures in Global and National Commerce Act (E-SIGN), a contract or signature "may not be denied legal effect" solely because it is in electronic form.[189] This principle, mirrored by state-level statutes (the Uniform Electronic Transactions Act adopted in most states), provides that agreements formed electronically – including those encoded on a blockchain – can be as legally binding as traditional paper contracts.[190] Several U.S. states have gone further to expressly recognize blockchain-based smart contracts. For example, Arizona amended its statutes in 2017 to declare that signatures, records, and contracts secured through blockchain technology are legally valid electronic signatures and records.[191] This Arizona law also explicitly defines and validates smart contracts, signaling a pro-blockchain stance at the state level. Other states such as Tennessee and Wyoming have enacted similar legislation to facilitate blockchain transactions and recognize crypto-assets as property under

[188] Pietro Ortolani, *The Impact of Blockchain Technologies on Dispute Resolution: Arbitration and Court Litigation in the Age of Decentralization*, 24(2) Uniform L. Rev. 430, 431–32 (2019); Marcelo Corrales et al., *Smart Contracts and Legal Challenges: Mapping the Issues*, 26 Eur. Rev. Private L. 809, 810–11 (2018).
[189] Electronic Signatures in Global and National Commerce Act, 15 U.S.C. § 7001(a) (2018); see also U.S. Department of Commerce, *Guide to Enactment of the UNCITRAL Model Law on Electronic Commerce* ch.1 (1996).
[190] Uniform Electronic Transactions Act § 7 & § 8 (Nat'l Conf. of Comm'rs on Unif. State L. 1999); *see* Ariz. Rev. Stat. Ann. § 44-7013 (West 2022).
[191] Ariz. Rev. Stat. Ann. § 44-7061 (2017); *see* Arizona H.B. 2417, 53rd Leg., 1st Reg. Sess. (2017).

commercial law.[192] These state initiatives illustrate an overall trend in the U.S.: adapting existing legal concepts (like signatures, records, and property) to encompass blockchain innovations, rather than treating smart contracts as sui generis instruments.

Cryptocurrency Regulation in Trade and Finance: U.S. regulation of cryptocurrency is multi-faceted and spread across different agencies and laws, leading to a complex mosaic rather than a unified approach. In the absence of a dedicated federal crypto statute, regulators classify crypto-assets within existing legal frameworks. The Securities and Exchange Commission (SEC) has deemed that certain crypto tokens may constitute "investment contracts" (and thus securities) under the Howey test, depending on the facts, and has pursued enforcement actions accordingly.[193] Concurrently, the Commodity Futures Trading Commission (CFTC) views major cryptocurrencies like Bitcoin as commodities, asserting jurisdiction over derivatives and fraud involving crypto-assets under the Commodity Exchange Act.[194] For anti-money laundering (AML) purposes, the Financial Crimes Enforcement Network (FinCEN) treats cryptocurrency exchanges and payment processors as money services businesses, requiring them to register and comply with Bank Secrecy Act obligations (including Know-Your-Customer checks and reporting of suspicious activities).[195] The Internal Revenue Service, for tax purposes, classifies virtual currencies as property, meaning that general tax principles applicable to property transactions (e.g., capital gains tax on sales) apply to crypto trades.[196] This regulatory patchwork has implications for international trade transactions using cryptocurrency: a U.S. company paying a foreign supplier in Bitcoin, for instance, might trigger securities law if the token is deemed a security, commodities law if derivatives are involved, and AML reporting for the financial intermediaries. Additionally, parties must consider export control and sanctions compliance (cryptocurrency payments to sanctioned entities are prohibited just as fiat payments would be). In short, while using cryptocurrency for cross-border

[192] *See, e.g.*, Tenn. Code Ann. § 47-10-202(c) (West 2020); Wyo. Stat. Ann. § 34-29-106 (2021).
[193] *See, e.g.*, SEC v. W.J. Howey Co., 328 U.S. 293 (1946); SEC, *Framework for 'Investment Contract' Analysis of Digital Assets* (Apr. 2019), https://www.sec.gov/corpfin/framework-investment-contract-analysis-digital-assets; SEC v. LBRY, Inc., No. 21-cv-00260, 2022 WL 16744741 (D.N.H. Nov. 7, 2022).
[194] In re Coinflip, Inc., [2015-2016 Transfer Binder] Comm. Fut. L. Rep. (CCH) ¶ 33,538 (C.F.T.C. Sept. 17, 2015); CFTC v. My Big Coin Pay, Inc., 334 F. Supp. 3d 492, 497–98 (D. Mass. 2018).
[195] FinCEN, *Guidance: Application of FinCEN's Regulations to Persons Administering, Exchanging, or Using Virtual Currencies* (Mar. 18, 2013), https://www.fincen.gov/sites/default/files/shared/FIN-2013-G001.pdf; 31 C.F.R. § 1022.210 (2023).
[196] Internal Revenue Serv. Notice 2014-21, 2014-16 I.R.B. 938 (Apr. 14, 2014), https://www.irs.gov/pub/irs-irbs/irb14-16.pdf.

trade is not outright illegal under U.S. law, it subjects the parties and intermediaries to multiple layers of compliance.

Commercial Law and Payment Systems Adaptation: Recognizing the growing role of digital assets in commerce, U.S. lawmakers have begun modernizing commercial statutes. In 2022, the Uniform Law Commission approved a set of amendments to the Uniform Commercial Code (UCC) to address transactions involving emerging technologies. Notably, the amendments introduce a new Article 12 on "controllable electronic records," explicitly addressing certain types of digital assets (including virtual currencies and electronic payment instruments) and establishing rules for their transfer and control.[197] These UCC amendments (which are being considered for enactment by individual states) provide default legal rules for transfers of crypto-assets and clarify how secured lending and negotiable instruments law can apply to digital records.[198] This development is particularly relevant for international trade finance: for example, a negotiable bill of lading or letter of credit recorded on a blockchain could qualify as a controllable electronic record under the revised UCC, thus enjoying the UCC's framework for enforceability and priority of interests – once states adopt these updates.[199] Apart from the UCC, traditional law on letters of credit and bills of lading (UCC Article 5 and 7, and the U.N. Convention on International Bills of Exchange, etc.) did not originally contemplate blockchain documents; the modern trend is to reinterpret or amend these laws to accommodate electronic equivalents. The U.S. has also not yet ratified the UNCITRAL Model Law on Electronic Transferable Records, but the UCC amendments serve a similar function domestically by giving legal effect to electronic trade documents.

Jurisdiction and Enforcement: A key challenge with smart contracts in the U.S. (as elsewhere) is determining jurisdiction and applicable law when disputes arise. Smart contracts can automatically execute trades or transfers without clear geographic situs. U.S. courts, when faced with disputes (for instance, a breach of a blockchain-based supply agreement or an oracle failure in a smart contract), will apply traditional choice-of-law rules: looking to any governing law clause in the contract (which parties are

[197] Uniform Law Commission & American Law Institute, *Uniform Commercial Code – 2022 Amendments*, Article 12, https://www.uniformlaws.org/committees/community-home?communitykey=1457c422-ddb7-40b0-8c76-39a1991651ac.
[198] *See* UCC § 12-104; UCC §§ 9-107A, 9-314(a).
[199] UCC § 12-105 & cmt. 5. *Cf.* UNCITRAL Model Law on Electronic Transferable Records, art. 10 (2017), https://uncitral.un.org/sites/uncitral.un.org/files/media-documents/uncitral/en/mletr_ebook_e.pdf.

advised to include even in a smart contract setting), or otherwise to connecting factors such as the domicile of the parties or location of performance.[200] To date, few published U.S. cases squarely address smart contract enforcement. However, general contract law principles suggest that a smart contract will be treated as enforceable if it meets the basic requirements (offer, acceptance, consideration, and intent, plus any formalities) Courts may need to interpret code and possibly seek expert evidence to understand the contractual intent from the computer program.[201] Notably, U.S. jurisdictions have demonstrated openness to recognizing crypto-assets as property that can be subject to legal processes. For example, in the case of *United States v. 50.44 Bitcoins*, a federal court treated cryptocurrency as a form of property subject to forfeiture, implicitly recognizing that such digital assets are things of value under law.[202] This property status matters in trade contexts (e.g. using crypto as collateral or payment) and aligns with moves in other common law jurisdictions to clarify the legal status of crypto-assets.

In summary, the U.S. approach to smart contracts and crypto in international trade is characterized by adaptation of existing laws and a regulatory patchwork. The upside of this approach is flexibility – many blockchain transactions can fit into established legal categories (contracts, property, securities, etc.) – but the downside is a lack of clarity or unified guidance. Parties to cross-border deals involving blockchain must navigate multiple legal regimes and ensure compliance with both federal and state law. The U.S. has so far relied on market-driven developments and case-by-case regulatory guidance, while broad legislative reform (apart from the UCC amendments and scattered state laws) remains nascent. This stands in contrast to the more top-down regulatory approach seen in some other jurisdictions, as discussed next.

4.3 European Union: Toward Harmonization with New Regulations

EU Strategy and Regulatory Landscape: The European Union has moved in recent years toward a more coordinated legal framework for crypto-assets and blockchain-based instruments, with an eye to supporting digital innovation in the single market while mitigating risks. Historically, EU member states adopted divergent approaches – for example, Germany treated certain crypto-assets as units of account (within financial

[200] *See generally* Syren Johnstone, *Smart Contracts and the Conflict of Laws*, 16 NYU J. L. & Bus. 365 (2020).
[201] *Cf.* David J. Koch, *Smart Contracts and the Courts: Off-Chain Enforcement of On-Chain Agreements*, 46 Hofstra L. Rev. 977, 987–90 (2018).
[202] United States v. 50.44 Bitcoins, No. CV 15-369, 2016 WL 3049166 (D. Md. May 31, 2016).

regulation), France created bespoke licensing for crypto service providers, and Malta enacted an extensive DLT regulatory regime – leading to a fragmented internal market.[203] To address this, the EU introduced *Markets in Crypto-Assets Regulation*, commonly known as MiCA, which was officially adopted in 2023. MiCA creates the first EU-wide comprehensive set of rules for the issuance and trading of crypto-assets (excluding those already regulated as financial instruments) and for the operation of crypto-asset service providers.[204] MiCA officially entered into force in June 2023, with its provisions applying in stages: rules for stablecoins took effect from 30 June 2024, and all remaining provisions—including requirements for white papers, licensing, and investor protection—applied from 30 December 2024.[205] The regulation's goal is to harmonize standards across all 27 EU countries, thereby reducing legal uncertainty and preventing regulatory arbitrage within the EU. For international trade, MiCA is significant because it will standardize how businesses in the EU can use cryptocurrencies for payments or fundraising – for example, a company in an EU country could more confidently accept a stablecoin from a foreign buyer knowing the stablecoin adheres to EU requirements on reserve assets and redemption rights.[206] Additionally, the EU's Fifth and Sixth Anti-Money Laundering Directives (AMLD 5 and 6) have already brought virtual currency exchanges and wallet providers into the scope of EU AML law, mandating customer due diligence and reporting, which aligns with FATF's recommendations and facilitates safer cross-border crypto transactions.[207]

Smart Contracts and Digital Transactions Law in the EU: Unlike the U.S., where contract law is decentralized by state and largely based on common law, the EU (and its civil law member states) tend to address electronic transactions through statutes and directives at both EU and national levels. The EU eIDAS Regulation (Regulation EU No. 910/2014) establishes a legal framework for electronic identification and trust services, ensuring that an electronic signature or record cannot be denied legal effect

[203] *See* European Securities and Markets Authority (ESMA), *Advice on Initial Coin Offerings and Crypto-Assets*, ESMA50-157-1391 (Jan. 2019), https://www.esma.europa.eu/sites/default/files/library/esma50-157-1391_crypto_advice.pdf; Philipp Paech, *The Governance of Blockchain Financial Networks*, 80 Mod. L. Rev. 1073, 1076–78 (2017).
[204] Regulation (EU) 2023/1114 of the European Parliament and of the Council of 31 May 2023 on Markets in Crypto-assets (MiCA), 2023 O.J. (L 150) 40.
[205] *See Id*.
[206] *See* Regulation (EU) 2023/1114, Recital 7.
[207] Directive (EU) 2018/843 of the European Parliament and of the Council of 30 May 2018, 2018 O.J. (L 156) 43; Directive (EU) 2018/1673 of the European Parliament and of the Council of 23 October 2018, 2018 O.J. (L 284) 22.

solely due to its electronic form across all member states.[208] While eIDAS does not specifically mention blockchain, its technology-neutral language encompasses signatures generated by blockchain protocols or smart contract code. This means a smart contract's cryptographic signature could be recognized as an electronic signature under EU law, giving presumptive validity to the signing process, especially if advanced or qualified electronic signature standards are met.

That said, the concept of "smart contracts" as automated programs has only recently entered EU legal discourse. In 2022, the European Commission proposed the Data Act,[209] a draft regulation aimed at establishing harmonised rules on fair access to and use of data across the European Union. Among its provisions, Article 30 specifically addresses smart contracts used in data sharing contexts, imposing legal and technical requirements to ensure features such as auditability, safe termination, and interruption mechanisms**.** While the Data Act does not directly regulate trade in goods, it represents one of the first instances in EU legislative history where smart contracts are explicitly addressed—signalling growing recognition of their legal significance in digital transactions.

For general commercial contracts and cross-border trade, most EU member states currently treat smart contracts under existing contract law principles. In jurisdictions such as Germany and France, traditional requirements of contract formation and validity—such as offer, acceptance, and legality—apply equally when agreements are concluded via code. Some civil law systems have been more proactive. Italy, for instance, became one of the first countries in the world to legally define "distributed ledger technology" and "smart contract" through legislation. Article 8-ter of Italian Law No. 12/2019[210] defines a smart contract as a computer program operating on a distributed ledger that automatically binds parties to pre-determined terms. The law further provides that such smart contracts satisfy the legal requirement of a "written form," provided the parties are electronically identified according to specified technical standards. This effectively grants smart contracts a status equivalent to written contracts

[208] Regulation (EU) No. 910/2014 of the European Parliament and of the Council of 23 July 2014, art. 25(1), 2014 O.J. (L 257) 73.
[209] Proposal for a Regulation of the European Parliament and of the Council on Harmonised Rules on Fair Access to and Use of Data (Data Act), COM(2022) 68 final, art. 30 (Feb. 23, 2022), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022PC0068.
[210] Decreto-legge 14 dicembre 2018, n. 135, conv. con mod. in Legge 11 febbraio 2019, n. 12, art. 8-ter (Italy).

under Italian law, establishing a statutory foundation for their enforceability—although Italian scholars continue to debate how traditional doctrines such as consent**,** mistake, or remedies for error apply in contracts executed solely through code.

Other EU jurisdictions have likewise made adjustments: for instance, France's 2019 PACTE Law[211] recognized the registration of certain financial instruments on blockchain, and Malta's Digital Innovation Authority Act 2018[212] created a regulatory framework for certifying blockchain platforms and smart contracts. These national-level efforts are expected to be complemented by broader EU-wide initiatives as they enter into force.

Cross-Border Recognition and Jurisdiction in the EU: Within the EU's single market, instruments like the Rome I Regulation on contract law[213] and Brussels I Regulation on jurisdiction[214] provide common rules that would apply to disputes arising from smart contracts or crypto transactions across member state borders. For example, Rome I allows parties to choose the governing law of an international contract; if a smart contract is used for an international sale of goods between, say, a French buyer and a German seller, they can designate the applicable law (and should do so explicitly even if the transaction is automated). If they do not, Rome I's default rules would determine the law based on factors like the habitual residence of the characteristic performer. In terms of dispute resolution, the EU has not created special mechanisms for blockchain disputes, so parties often rely on arbitration or traditional litigation. Notably, European institutions have explored the concept of blockchain-based dispute resolution and arbitration for cross-border transactions, but these remain in experimental stages.[215] Any judgment from a member state court relating to a blockchain or crypto dispute would be enforceable throughout the EU via the Brussels regime, just like any other civil judgment, which provides some reassurance of legal recourse despite the novelty of the subject matter.

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[211] Loi n° 2019-486 du 22 mai 2019 relative à la croissance et la transformation des entreprises [PACTE Law] (France).
[212] Malta Digital Innovation Authority Act, Cap. 591 of the Laws of Malta (2018).
[213] Regulation (EC) No 593/2008 of the European Parliament and of the Council of 17 June 2008 on the Law Applicable to Contractual Obligations (Rome I), 2008 O.J. (L 177) 6.
[214] Regulation (EU) No 1215/2012 of the European Parliament and of the Council of 12 December 2012 on Jurisdiction and the Recognition and Enforcement of Judgments in Civil and Commercial Matters (Recast), 2012 O.J. (L 351) 1.
[215] Roger Mougalas, *Blockchain Arbitration and Smart Contract Dispute Resolution*, 37 J. Int'l Arb. 487, 489–90 (2020).

Trade Facilitation and Digital Trade Initiatives: The EU is also active in international forums on digital trade. While the World Trade Organization has yet to produce blockchain-specific rules, the EU has championed initiatives on electronic commerce that indirectly support blockchain adoption (for example, by pushing for the legal recognition of electronic transferable records in free trade agreements and at UNCITRAL). The United Nations Commission on International Trade Law's Model Law on Electronic Transferable Records (MLETR) of 2017, which enables legal use of electronic bills of lading and promissory notes, influenced some EU countries – though the EU as a whole has not yet adopted it. Individual states like Singapore (discussed below) have implemented MLETR, and the EU is observing these developments. There is ongoing work within bodies like the International Chamber of Commerce and the EU's trade facilitation programs to encourage acceptance of digital trade documents (which could be implemented via blockchain).[216] Overall, the EU's approach balances innovation with regulation. MiCA and related reforms indicate a willingness to integrate crypto-assets into the mainstream financial and legal system under clear rules, while existing principles in contract and commerce law are being interpreted (and occasionally reformed) to accommodate smart contracts. Businesses engaging in international trade with EU counterparties should benefit from the increasing legal certainty as these frameworks come into effect, though compliance burdens (e.g. licensing under MiCA, rigorous AML checks) will also rise.

4.4 Singapore: Proactive and Facilitative Approach

Singapore is widely regarded as a jurisdiction that actively promotes fintech innovation, including the use of blockchain in trade and finance, through a combination of forward-looking regulation and government support. This is evident in its treatment of both smart contracts and cryptocurrency transactions.

Recognition of Electronic Contracts and Trade Documents: Singapore's legal system, based on common law, has readily accommodated electronic contracting, providing a favorable environment for smart contracts. The Electronic Transactions Act of Singapore (ETA), originally enacted in 1998 and updated over time, gives legal effect to electronic records and signatures, mirroring principles found in laws like the

[216] International Chamber of Commerce, *ICC Digital Roadmap for Trade* (2021); United Nations Convention on the Use of Electronic Communications in International Contracts, art. 11, opened for signature Nov. 23, 2005, 2898 U.N.T.S. 3.

UNICTRAL Model Law on Electronic Commerce. In 2021, Singapore significantly amended the ETA to adopt the UNCITRAL Model Law on Electronic Transferable Records – becoming one of the first countries to do so.[217] The Electronic Transactions (Amendment) Act 2021 explicitly enabled the creation and use of *electronic transferable records* (including bills of lading, bills of exchange, promissory notes, warehouse receipts, etc.), granting them the same legal validity as their paper counterparts, provided certain requirements are met.[218] Under the amended ETA, a document like an electronic bill of lading (eBL) on a blockchain-based platform is legally recognized; it satisfies any "writing" or "possession" requirements by virtue of a reliable electronic record that is unique and transferable. This legal reform has direct implications for international trade: parties can engage in completely digital trade finance transactions, with Singapore law assuring that the electronic documents will be accepted as valid and enforceable.[219] Singapore also aligned its laws with the UNCITRAL Electronic Communications Convention by refining rules on when an electronic communication (such as a notice sent via a blockchain system) is deemed received, which facilitates cross-border contract formation by electronic means.[220] In effect, Singapore's statutory framework is highly supportive of smart contracts that execute trade transactions – the code-based performance is underpinned by statutes confirming such performance is legally effective.

Cryptocurrency Regulation and Payments: On the cryptocurrency side, Singapore's approach is often characterized as "regulate to enable." Rather than ban crypto activities, Singapore regulates them under a clear licensing regime primarily for risk management. The Monetary Authority of Singapore (MAS), which is both the central bank and financial regulator, introduced the Payment Services Act 2019 (effective January 2020) to consolidate and update regulation of payment systems and digital payment services, including cryptocurrency dealings.[221] Under the Payment Services

[217] Electronic Transactions (Amendment) Act 2021 (No. 3 of 2021) (Singapore) (amending the Electronic Transactions Act, Cap. 88). *See* Infocomm Media Development Authority (IMDA) & Ministry of Communications and Information, *Factsheet: Benefits of Electronic Transferable Records* (Mar. 19, 2021), https://www.imda.gov.sg/-/media/imda/files/news-and-events/media-room/media-releases/2021/02/factsheet-proposed-amendments-to-eta.pdf.
[218] Electronic Transactions Act, Cap. 88, §§ 6, 6A (Sing.) (as amended). *See* Singapore Parliamentary Debates, Electronic Transactions (Amendment) Bill – Second Reading, Feb. 1, 2021.
[219] Allen & Gledhill LLP, *Electronic Transactions Act Amended on 19 March 2021 to Include Electronic Transferable Records* (22 Mar. 2021), https://www.allenandgledhill.com/media/9632/ag-lb-03-2021.pdf.
[220] *Id.*
[221] Payment Services Act 2019, No. 2 of 2019 (Sing.).

Act (PSA), activities such as exchanging digital payment tokens (the term used for cryptocurrencies) or facilitating their transfer are defined as regulated payment services. Businesses that provide crypto exchange or custody services in Singapore must obtain licenses (either as major payment institutions or standard payment institutions, depending on transaction volumes) and comply with requirements on consumer protection, AML/CFT, technology risk management, and so forth.[222] For example, a crypto exchange operating in Singapore must implement robust AML checks in line with FATF standards, report suspicious transactions, and segregate customer assets. These regulations give legitimacy to crypto transactions by bringing them into the regulated financial fold, which in turn supports their use in legitimate commerce. A Singapore trading company can, for instance, accept payment in cryptocurrency from an overseas client, and the local crypto payment provider handling the transaction would be a licensed entity subject to oversight, reducing counterparty risk. Singapore does not treat cryptocurrencies as legal tender, but it does treat them as digital commodities or assets that can be owned, transferred, and subject to taxation (Singapore currently has no capital gains tax, and for GST (sales tax) purposes, cryptocurrency used as payment for goods/services is treated like a barter trade, with GST applied to the goods/services, not the crypto itself). MAS has periodically issued guidance and warnings to consumers about crypto risks, but remains committed to supporting blockchain innovation – for example, through its "Project Ubin" (a project researching blockchain use in multi-currency payment and settlement networks) and facilitating industry sandboxes for blockchain applications.

Smart Contracts in Singapore Law: Singapore's judiciary and legal profession have also grappled with issues surrounding smart contracts and crypto assets, often in a pragmatic fashion. In the case of *B2C2 Ltd v. Quoine Pte Ltd* (2019), one of the first high-profile cases involving cryptocurrency, the Singapore International Commercial Court dealt with a dispute arising from an algorithmic trading contract on a cryptocurrency exchange. While the case was resolved on narrow grounds (finding that the exchange wrongfully reversed certain trades), the court assumed for the sake of argument that cryptocurrencies could be treated as property and that ordinary principles

[222] Monetary Auth. of Singapore, *Notice PSN02: Prevention of Money Laundering and Countering the Financing of Terrorism – Digital Payment Token Service Providers* (Apr. 2, 2024), https://www.mas.gov.sg/-/media/mas-media-library/regulation/notices/amld/psn02-aml-cft-notice---digital-payment-token-service/notice-psn02-dated-2-april-2024.pdf.

of contract (e.g., mistake) could apply even when the contract was executed by computer programs without direct human involvement at the moment of execution.[223] The Singapore Court of Appeal in the subsequent appeal ([2020] SGCA(I) 02) confirmed that general contract law doctrines apply to contracts formed by algorithms, hinting that a smart contract – which is essentially automated execution of an agreement – is not immune from legal scrutiny if, say, the code does something unintended or one party claims the outcome is unjust. Importantly, Singapore's legal community has actively engaged with international developments such as the UK Jurisdiction Taskforce's Legal Statement on Cryptoassets and Smart Contracts. The Singapore Academy of Law has indicated agreement with the view that cryptoassets are property and smart contracts can create binding legal obligations, aligning Singapore with other common law jurisdictions on fundamental definitions.[224] By clarifying these foundational issues (through cases or guidance), Singapore gives businesses confidence that their blockchain-based transactions will be recognized in court if disputes arise.

Cross-Border and International Initiatives: As a major trading hub, Singapore has an interest in promoting legal interoperability for digital trade. It has been involved in discussions at forums like UNCITRAL and the Asia-Pacific Economic Cooperation (APEC) regarding digital trade regulations. In 2020, Singapore Chile, and New Zealand launched launched the Digital Economy Partnership Agreement (DEPA), which contains provisions encouraging paperless trade and the use of electronic transferable records, reflecting Singapore's intent to take those MLETR-inspired domestic laws to an international level for mutual recognition.[225] Furthermore, Singapore's customs and port authorities have experimented with blockchain platforms (for example, TradeTrust and the OpenCerts platform for certifying trade documents) and have worked with international partners to ensure legal validity of those digital documents across borders. Domestically, Singapore's courts can handle international tech disputes through the Singapore International Commercial Court and international arbitration centers, which stand ready to deal with disputes arising from smart contracts or crypto trade issues. The enforceability of foreign judgments or arbitral awards relating to blockchain

[223] *B2C2 Ltd v. Quoine Pte Ltd*, [2019] SGHC(I) 03 (Singapore International Commercial Court). On appeal: *Quoine Pte Ltd v. B2C2 Ltd*, [2020] SGCA(I) 02 at ¶144 (Singapore Court of Appeal).
[224] *Cf.* Khoo Teng Aun v. Classic Worldwide Corp., [2022] SGHC 19 (Singapore High Court).
[225] *See* Digital Economy Partnership Agreement, Sing.–Chile–N.Z., signed June 12, 2020, https://www.mti.gov.sg/-/media/MTI/Microsites/DEAs/Digital-Economy-Partnership-Agreement/Text-of-the-DEPA.pdf.

transactions is facilitated by Singapore's participation in treaties like the New York Convention on arbitration.

In summary, Singapore's approach is highly facilitative: it modernized its laws (ETA and PSA) to remove legal barriers to blockchain use, actively regulates crypto businesses to provide a safe environment, and clarifies through case law and policy statements that smart contracts and cryptoassets are recognized under law. This pro-business legal certainty, combined with strong rule of law, makes Singapore a leading jurisdiction for deploying blockchain solutions in trade. A company engaged in international trade can reliably use Singapore law to govern a smart contract and trust that both the code and the crypto payments will be given effect under that law, with minimal uncertainty.

4.4.1 Legal Opportunities Created by Pro-Enabling Frameworks

While much of the discourse surrounding blockchain and cryptocurrency regulation focuses on legal uncertainties and enforcement challenges, it is equally important to recognize the substantial legal opportunities presented by jurisdictions that have adopted forward-looking, enabling frameworks. These opportunities are particularly evident in jurisdictions like the United States and Singapore, which have taken concrete legislative steps to support the mainstream adoption of blockchain-based instruments in international trade.

In the United States, the Uniform Law Commission (ULC)'s 2022 amendments to the Uniform Commercial Code (UCC) introduce a new Article 12, which governs "controllable electronic records"—a category designed to include blockchain-based digital assets such as smart contracts and crypto-tokens. Article 12 provides a legal structure for the transfer of such records, including establishing the rights of a "qualifying purchaser" and detailing how control of digital assets can be evidenced and perfected. This development offers significant legal certainty for the use of blockchain instruments in trade finance, enabling the secure transfer of electronic bills of lading, letters of credit, and payment tokens under a predictable legal regime. By embedding these reforms into the commercial code, the UCC amendments reduce the risks

associated with legal enforceability and enhance the confidence of commercial actors transacting across borders using blockchain systems.[226]

Similarly, Singapore's Electronic Transactions Act (ETA)—especially as amended in 2021 to incorporate the UNCITRAL Model Law on Electronic Transferable Records (MLETR)—has created a robust legal foundation for blockchain-based trade documentation. By granting legal equivalence to electronic transferable records such as e-bills of lading, the ETA enables parties to a cross-border transaction to rely on digitally issued and transferred documents with the same legal force as their paper counterparts.[227] This legislative clarity removes barriers to fully digitized trade flows and allows for end-to-end automation of supply chain processes using smart contracts, thereby lowering transaction costs, minimizing delays, and improving compliance through immutability and transparency.[228]

Moreover, these legal advancements enhance interoperability with international legal instruments. The Singaporean model, in particular, is aligned with UNCITRAL's global vision of legal harmonization in digital trade, and it offers a replicable framework for other jurisdictions seeking to modernize their trade laws without undermining legal certainty.[229] Together, the reforms in these jurisdictions illustrate that law can serve not only as a safeguard but also as a facilitator of innovation, providing a regulatory infrastructure that legitimizes blockchain-based transactions while promoting accountability, enforceability, and trust in digital commerce.

4.5 India: Evolving Stance from Restriction to Cautious Engagement

India's approach to cryptocurrencies and smart contracts has been markedly more cautious, shaped by concerns over financial stability, illicit activity, and consumer protection. Nevertheless, it is evolving. In the context of international trade, India represents a jurisdiction that until recently leaned heavily toward restriction of crypto-assets, but is now exploring regulatory frameworks rather than outright bans.

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[226] U.C.C. § 12-105 cmt. 2 (Amended 2022), reprinted in ULC, *Uniform Commercial Code Amendments (2022), https://www.restructuring-globalview.com/wp-content/uploads/sites/21/2023/10/UCC-Amendments_2022_Final-Act-with-Comments_8-1.pdf.*

[227] Electronic Transactions (Amendment) Act 2021 (Singapore), No. 3/2021; see also Infocomm Media Development Authority (IMDA), *Guide to Adopting the UNCITRAL Model Law on Electronic Transferable Records in Singapore* (2021), https://www.imda.gov.sg/-/media/imda/files/news-and-events/media-room/media-releases/2021/02/factsheet-proposed-amendments-to-eta.pdf.

[228] UNCITRAL, *Model Law on Electronic Transferable Records* (2017), U.N. Doc. A/72/17.

[229] Singapore Ministry of Trade and Industry, *Digital Economy Agreements – Fact Sheet* (2022).

Historical Ban and Supreme Court Reversal: For a period, India effectively prohibited dealing in cryptocurrencies through banking channels. In April 2018, the Reserve Bank of India (RBI, India's central bank) issued a circular titled "Prohibition on dealing in Virtual Currencies," directing all regulated financial institutions to cease providing services to any individuals or businesses involved in cryptocurrency transactions.[230] This policy made it extremely difficult for crypto exchanges to operate (they could not maintain bank accounts) and signalled a broadly hostile view toward crypto-assets, motivated by the RBI's concerns that cryptocurrencies could facilitate money laundering, undermine the banking system, and evade capital controls. The banking ban was challenged in court by industry stakeholders, and in a landmark judgment in March 2020, the Supreme Court of India struck it down. In *Internet and Mobile Ass'n of India v. Reserve Bank of India* (2020), the Supreme Court held that the RBI's blanket ban was disproportionate and unsupported by evidence of actual harm, especially given that cryptocurrency trading was not outright illegal by any law enacted by Parliament.[231] The court's decision invalidated the RBI's circular, thereby reopening the door for crypto exchanges and traders in India by restoring their access to banking.[232] This case is notable in that India's highest court acknowledged the legitimacy of cryptocurrency business (absent legislation to the contrary) and emphasized that central bank regulation must be proportionate.[233] Following the judgment, exchanges that had moved offshore resumed operations in India, albeit amid regulatory uncertainty.[234]

Current Regulatory Framework and Proposed Legislation: As of 2025, India does not have a dedicated law governing smart contracts or cryptocurrencies, leaving a regulatory vacuum that the government has been deliberating how to fill.[235] A

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[230] Reserve Bank of India, Notification RBI/2017-18/154, *Prohibition on dealing in Virtual Currencies (VCs)* (Apr. 6, 2018), https://www.rbi.org.in/commonman/Upload/English/Notification/PDFs/NT154ML060418.PDF. *See* Internet and Mobile Ass'n of India v. RBI, (2020) 10 SCC 274, ¶ 6 (India).

[231] *Internet and Mobile Ass'n of India v. Reserve Bank of India*, (2020) 10 SCC 274 (Supreme Court of India, decided Mar. 4, 2020). *Id.* at ¶ 168–169.

[232] *Internet & Mobile Ass'n of India v. Reserve Bank of India*, 2020 SCC OnLine SC 275 (India)

[233] Let's Trade Crypto: Indian Supreme Court Quashes Prohibition, *Oxford Bus. L. Blog* (Mar. 2020), https://blogs.law.ox.ac.uk/business-law-blog/blog/2020/03/lets-trade-crypto-indian-supreme-court-quashes-prohibition (last visited April 07, 2025).

[234] Virtual Currencies in India: A New Dawn, *Cyril Amarchand Mangaldas Blog* (Mar. 7, 2020), https://corporate.cyrilamarchandblogs.com/2020/03/virtual-currencies-cryptocurrency-in-india-a-new-dawn (last visited April 07, 2025).

[235] KYC Hub, *Cryptocurrency Regulations in India: A Guide for 2025* (May 8, 2025), https://www.kychub.com/blog/cryptocurrency-regulations-in-india/.

government committee in 2019 recommended a draft bill that would ban cryptocurrencies (with harsh penalties) while creating an official sovereign digital currency, but that draft Banning of Cryptocurrency & Regulation of Official Digital Currency Bill, 2019 was never introduced in Parliament.[236] Subsequent public statements by the government indicated a shift in view – rather than an outright ban, the government signalled interest in a balanced regulatory approach in coordination with global efforts. In 2021 and 2022, as crypto popularity in India surged, the government began work on new legislation (sometimes referred to as the Cryptocurrency and Regulation of Official Digital Currency Bill, 2021), but deferred introducing it, awaiting international consensus and further study. In the meantime, India's approach has been to treat crypto-assets as taxable and subject them to certain reporting rules, even in the absence of a formal legal status. Notably, the Finance Act 2022 introduced specific provisions taxing "virtual digital assets." Gains from the sale of cryptocurrency in India are now subject to a flat 30% income tax (similar to lottery or speculative transaction taxation), and a 1% Tax Deducted at Source (withholding tax) applies on payments for the transfer of crypto assets above a small threshold, effective July 2022.[237] By taxing crypto transactions (and defining "virtual digital asset" in the tax law), India implicitly recognizes these assets as a legitimate subject of commerce, even though it has yet to pass comprehensive regulatory legislation. The tax approach aims to discourage speculative frenzy (through high taxation) while collecting revenue and gathering transaction data (via TDS reporting). However, from a legal standpoint, crypto trading and use in payments remain in a grey area – not illegal per se, but also not formally regulated by a securities or commodities law regime. The RBI, for its part, remains skeptical: it has consistently warned users, merchants, and banks of the risks of virtual currencies and in 2022 launched its own pilot of a Central Bank Digital Currency (the digital rupee) as an official alternative.[238]

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[236] Inter-Ministerial Comm., *The Draft Banning of Cryptocurrency & Regulation of Official Digital Currency Bill, 2019* (India), https://prsindia.org/billtrack/draft-banning-of-cryptocurrency-regulation-of-official-digital-currency-bill-2019 (last visited April 07, 2025).

[237] Finance Act, 2022 (India), inserting Section 115BBH in the Income-tax Act, 1961 and Section 194S. *See* Government of India, Ministry of Finance, *Budget Speech 2022–23* (Feb. 1, 2022), https://www.indiabudget.gov.in/doc/bspeech/bs202223.pdf.

[238] Reserve Bank of India, *Report on Currency and Finance 2021-22* (Feb. 2022), https://www.rbi.org.in/commonman/Upload/English/PressRelease/PDFs/PR13004052022.pdf; RBI, *Concept Note on Central Bank Digital Currency* (Oct. 2022), https://rbidocs.rbi.org.in/rdocs/PublicationReport/Pdfs/CONCEPTNOTEACB531172E0B4DFC9A6E506C2C24FFB6.PDF.

Smart Contracts and Electronic Transactions: India does not have any statute or court ruling specifically on smart contracts in the way some other jurisdictions do. However, India's Information Technology Act, 2000 provides legal recognition to electronic records and electronic signatures (similar to principles in UNCITRAL's e-commerce law), which could encompass certain aspects of blockchain transactions. For example, Section 10-A of the IT Act validates contracts formed through electronic means. In theory, this would include agreements formed by the exchange of electronic messages or possibly by the interaction of automated systems (which is what a smart contract is). Additionally, the Bharatiya Sakshya Adhiniyam, 2023, which replaced the Indian Evidence Act, allows electronic records to be admitted as evidence, subject to compliance with Sections 61 and 62, which require proof of authenticity and the filing of a certificate to demonstrate integrity and origin of the electronic record.[239] A smart contract's code and ledger entries could, under these provisions, be used as evidence of the terms of an agreement or its performance. But these laws have not been tested specifically for blockchain-based self-executing contracts. No Indian legislation yet equates a blockchain record or time-stamp with a notarization or "written" instrument (unlike Italy or Arizona's approaches). Thus, if two parties in India (or involving India) utilize a smart contract for a trade transaction, they would be wise to also have a traditional contract or at least ensure that the smart contract's terms are also recorded in natural language form to avoid any uncertainty in enforcement. Indian contract law (largely based on the Indian Contract Act, 1872) would in principle apply to any agreement, regardless of form, so long as basic requirements (free consent, lawful object, etc.) are met. One can expect that, when Indian courts face a dispute over a smart contract, they will apply those traditional doctrines. Given India's common law heritage, courts might look for persuasive precedents from other jurisdictions (such as the UK or Singapore decisions) for guidance on issues like whether a piece of self-executing code can be considered a binding agreement or how to handle mistakes or unforeseen outcomes in automated execution.[240]

Use of Cryptocurrency in Trade and Forex Regulations: One reason India has been wary of private cryptocurrencies is the country's strict foreign exchange control regime. The Foreign Exchange Management Act (FEMA) and RBI regulations tightly control

[239] Bharatiya Sakshya Adhiniyam, No. 47 of 2023, §§ 61–62, Gazette of India, pt. II, sec. 1 (Sept. 2023).
[240] *Cf.* Tech Mahindra Ltd. v. Surbhi Singhal, 2020 SCC OnLine Del 1102 (High Court of Delhi).

currency outflows and the use of foreign currency in domestic transactions. It is currently not legally permitted for Indian businesses or individuals to use cryptocurrency as a substitute for foreign currency to settle cross-border trades or to evade import-export regulations. For instance, an Indian importer is supposed to pay in foreign currency (like USD) through the banking system for any import; using Bitcoin or another crypto to pay a foreign supplier would fall outside existing FEMA regulations and could be deemed unlawful (since it would be akin to paying with an unapproved currency and avoiding reporting). Until Indian law explicitly addresses this, companies face legal risk in using crypto for cross-border trade settlement. That said, there have been anecdotal reports of traders quietly experimenting with crypto for evading certain trade restrictions or sanctions, which only reinforces regulators' concerns.[241] As global norms develop, India might incorporate crypto within FEMA by classifying it as a foreign asset or currency for regulatory purposes, but as of now no such formal mechanism exists.

Future Outlook and International Coordination: India has taken up the issue of crypto regulation in international forums, particularly during its G20 presidency in 2023. The G20, at India's behest, has discussed the need for a coordinated global framework to prevent regulatory arbitrage and illicit use of crypto-assets.[242] India's position emphasizes that because cryptocurrencies transcend borders, national measures may be insufficient and a global consensus (perhaps on information sharing, common standards for exchanges, and maybe even a global law enforcement coordination mechanism) is needed. Domestically, it is expected that India will eventually enact legislation – likely after seeing the effects of MiCA in the EU and regulatory experiments elsewhere – that will regulate crypto trading platforms, impose investor protection rules, and formalize the taxonomy of crypto-assets (possibly distinguishing utility tokens, security tokens, etc.). Such a law might also address smart contracts or at least mandate certain disclosures or dispute mechanisms for automated contracts, especially if used in consumer-facing contexts. For now, participants in the Indian market or those dealing with Indian counterparties in crypto-related trade must navigate

[241] *See* KYC Hub, *Cryptocurrency Regulations in India: A Guide for 2025* (Apr. 2024), https://www.kychub.com/blog/cryptocurrency-regulations-in-india/; Ashish Deep Verma, *Cryptocurrency in India: A Guide to Taxation and Compliance in 2025*, Bar & Bench (Apr. 28, 2025), https://www.barandbench.com/view-point/cryptocurrency-in-india-a-guide-to-taxation-and-compliance-in-2025.

[242] G20 Leaders' Declaration ¶ 14, Bali, Nov. 16, 2022, https://g20.org/wp-content/uploads/2024/09/2022-11-16-g20-declaration-data.pdf.

a patchwork of partial measures: a void of direct regulation filled by central bank caution, high taxes, general IT law for electronic records, and the overarching contract and exchange control law which treat crypto transactions as suspicious outliers. Legal practitioners advise extreme caution and case-by-case analysis for any cross-border deal involving crypto and India, often structuring such deals under foreign law or through jurisdictions like Singapore to mitigate uncertainty.[243]

In summary, India's legal approach to smart contracts and crypto in trade has moved from near-prohibition toward engagement, but it remains the most restrictive and uncertain of the jurisdictions discussed. The transformation is ongoing – the judiciary's intervention opened the space, taxation asserted state interest in the area, and new laws are anticipated. Businesses must keep abreast of rapid changes in India's policy and the potential for sudden regulatory actions. A comparative perspective shows India in stark contrast to places like Singapore or the EU; this divergence itself underscores the broader theme that lack of international harmonization creates significant compliance challenges.

4.5.1 Critical Assessment of Jurisdictional Effectiveness

While each jurisdiction exhibits efforts toward accommodating blockchain in international trade, the effectiveness of these legal frameworks varies significantly in addressing the doctrinal challenges identified in Chapter 3. The United States, for instance, benefits from legal flexibility under common law and the adaptability of the Uniform Commercial Code, including the new Article 12. However, the absence of federal uniformity and competing interpretations by agencies like the SEC and CFTC lead to regulatory fragmentation, which undermines legal certainty for cross-border crypto transactions.[244] Scholars argue that this patchwork reduces the practical enforceability of blockchain-based contracts across states and international lines, unless parties carefully select governing law and forum.[245]

In contrast, the European Union's MiCA Regulation offers legal harmonization, but its effectiveness may be hampered by its sector-specific scope and the ongoing evolution

[243] *See* Saranya Ghosh, *Crypto-Contracting: Mitigating Legal Risk in Cross-Border Blockchain Transactions*, 15 NALSAR L. Rev. 101, 122–25 (2022).
[244] U.C.C. § 12-105 cmt. 2 (Amended 2022); see also Chris Brummer & Yesha Yadav, Fintech and the Innovation Trilemma, 107 Geo. L.J. 235, 278–79 (2019).
[245] Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* 97–99 (Harv. Univ. Press 2018).

of member-state implementation.[246] Critics note that while MiCA increases transparency and consistency, its overemphasis on stablecoin governance and its silence on decentralized protocols may leave several gaps unresolved in dynamic trade environments.[247] Furthermore, MiCA's AML obligations, while aligned with FATF guidelines, can increase compliance burdens for small international traders.[248]

Singapore, by contrast, has demonstrated a high degree of regulatory foresight through its amendment of the Electronic Transactions Act and its implementation of the Payment Services Act. Its legal system clearly supports blockchain documentation, and courts have already recognized the validity of algorithmic trading and smart contracts.[249] However, scholars warn that excessive regulatory comfort may lead to institutional complacency in adapting to newer models like DAOs (Decentralized Autonomous Organizations) or algorithmic stablecoins.[250]

India's framework remains the most ambiguous and risk-averse, relying on general contract law, a punitive tax regime (30% and 1% TDS), and policy hesitancy.[251] Legal commentators observe that this has led businesses to avoid crypto-denominated trade transactions within India, frequently structuring deals under Singaporean or English law to mitigate uncertainty.[252] The lack of judicial or legislative clarity on whether smart contracts meet the requirements of offer, acceptance, and intent has led to legitimate doubts over enforceability.[253]

Ultimately, while comparative study shows progress in all four jurisdictions, gaps in enforceability, classification, and jurisdictional clarity still pose real threats to

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[246] Regulation 2023/1114, 2023 O.J. (L 150) 40 (EU) (Markets in Crypto-Assets Regulation).
[247] Dirk A. Zetzsche et al., The Markets in Crypto-Assets Regulation (MiCA) and the EU Digital Finance Strategy: A Conceptual and Legal Critique, 57 Tex. Int'l L.J. 1, 25–27 (2022).
[248] Financial Action Task Force, *Updated Guidance for a Risk-Based Approach to Virtual Assets and Virtual Asset Service Providers* 12–14 (Oct. 2021), https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Updated-Guidance-VA-VASP.pdf.coredownload.inline.pdf.
[249] *B2C2 Ltd. v. Quoine Pte. Ltd.*, [2020] SGCA(I) 2; Electronic Transactions (Amendment) Act 2021 (Singapore).
[250] See Tan Kah Chye, The DAO Dilemma: Singapore's Regulatory Edge and Its Legal Uncertainties, 39 Sing. L. Rev. 118, 124–25 (2022).
[251] The Finance Act, 2022, No. 6, Acts of Parliament, 2022 (India), https://apct.gov.in/gstportal/GST_Portal/pdf/Acts_Rules/Finance%20Act%20No.06%20of%202022(CGST).pdf; see also KYC Hub, *Cryptocurrency Regulations in India: A Guide for 2025* (May 8, 2025), https://www.kychub.com/blog/cryptocurrency-regulations-in-india/.
[252] Pratik Datta, Lawless Contracts: Crypto and the Problem of Enforceability in India, 5 Indian J.L. & Tech. Pol'y 23, 34–36 (2023).
[253] Shreya Suri & Aditi Agarwal, Smart Contracts Under Indian Law: An Analysis, 14 NUJS L. Rev. 67, 75–77 (2021).

blockchain's utility in international trade. The next chapter proposes ways to bridge these legal voids through coordinated reform and international harmonization.

4.6 Comparative Analysis and International Efforts

The above examination reveals markedly different legal approaches to smart contracts and cryptocurrency in international trade across jurisdictions:

- **Regulatory Philosophy:** Singapore and the EU actively create legal frameworks to integrate crypto and smart contracts into the economy (enabling innovation with oversight), whereas India has been cautious, prioritizing risk containment and slower implementation. The United States lies somewhere in between, with innovation largely driven by the private sector and state initiatives, and a slower federal regulatory response, reflecting a decentralized regulatory structure.

- **Legal Certainty for Smart Contracts:** Jurisdictions like Arizona (U.S. state), Italy, and Singapore have explicitly validated smart contracts and blockchain records in law, providing higher legal certainty that an automated trade contract will be enforceable. By contrast, in jurisdictions without explicit recognition, enforceability relies on traditional contract interpretation, which may introduce uncertainty if a dispute arises from code executing in unintended ways. Common law systems (U.S., Singapore, UK) tend to adapt case law flexibly, whereas civil law systems (most of EU) may require legislative action or doctrinal development to address novel questions – which Italy's example shows is happening.

- **Crypto-Asset Classification and Use:** The EU through MiCA is defining categories of crypto-assets and establishing passportable regulations, reflecting a top-down harmonization. The U.S. uses existing financial laws, which has led to overlapping classifications (commodity vs security) and regulatory competition among agencies, potentially yielding inconsistent outcomes. Singapore treats crypto predominantly as a payment and investment issue and licenses it accordingly, aligning with global standards. India so far simply treats crypto as an untamed asset class subject to taxation and potential future prohibition or regulation; its stance significantly limits the use of crypto in trade at present. These differences mean, for example, that a stablecoin regarded as a legitimate means of payment in the EU (under MiCA's e-money token rules) might not be

accepted or could even be deemed unlawful in India's capital-controlled economy. Harmonizing such divergent views is a major challenge.

- **AML and Compliance:** One area of convergence is anti-money laundering (AML) regulation. All examined jurisdictions either have imposed (EU, Singapore, US) or are in process of imposing (India, via draft rules or existing financial norms) AML controls on crypto transactions in line with the Financial Action Task Force (FATF) recommendations. FATF's 2021 updated guidance on virtual assets sets forth the "travel rule" and risk-based approach that requires VASPs (Virtual Asset Service Providers) globally to collect and share originator/beneficiary information for transfers, among other measures.[254] The EU's AML directives, U.S. FinCEN regulations, Singapore's PSA rules, and even RBI's concerns in India all stem from this common framework. In international trade, compliance with these standards is critical – a blockchain payment across borders will entail exchanges or banks implementing these rules. While this doesn't eliminate legal disparities, it does create a baseline of conduct expected worldwide.

- **Jurisdiction and Dispute Resolution:** Smart contracts and crypto transactions complicate questions of applicable law and forum. Parties are increasingly turning to arbitration and specialized dispute forums for blockchain disputes, given enforceability of arbitral awards under the New York Convention in 168 countries (this is easier than trying to enforce one country's court judgment in another country where crypto laws differ). There are proposals for bespoke blockchain arbitration (even arbitrators acting on-chain). For example, scholars have suggested that code-based dispute resolution mechanisms could be integrated with legal oversight, but that raises its own issues.[255] For now, traditional private international law rules govern. The lack of a treaty specifically addressing recognition of digital contracts or crypto-assets means parties must rely on

[254] Financial Action Task Force (FATF), *Updated Guidance for a Risk-Based Approach to Virtual Assets and Virtual Asset Service Providers* 60–66 (Oct. 2021), https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Updated-Guidance-VA-VASP.pdf.coredownload.inline.pdf; FATF, *12-Month Review of the Revised FATF Standards on Virtual Assets* (June 2020), https://www.fatf-gafi.org/content/dam/fatf-gafi/reports/12-Month-Review-Revised-FATF-Standards-Virtual-Assets-VASPS.pdf.coredownload.inline.pdf; *see* Ministry of Finance (India), Gazette Notification S.O. 1072(E) (Mar. 7, 2023), https://egazette.gov.in/WriteReadData/2023/244184.pdf.

[255] Marta Čevová, *Smart Contract Arbitration: The Future of Dispute Resolution*, 37 J. Int'l Arb. 381 (2020).

general instruments (like UNCITRAL Model Laws, the Hague Choice of Court Convention, etc., if applicable). International bodies have been examining these problems: UNCITRAL has ongoing work on identity management and possibly future work on digital assets; the Hague Conference has considered whether its existing conventions are sufficient for digital assets.

- **Towards Harmonization:** Efforts to harmonize laws are underway but at early stages. UNCITRAL's texts (the Electronic Communications Convention 2005, MLETR 2017) and ICC's initiatives on digital trade are gradually being adopted by leading trading nations (e.g., Singapore, and recently the UK's Electronic Trade Documents Act 2023 which was influenced by MLETR principles). These instruments indirectly support smart contracts in trade by modernizing the legal status of electronic documents and communications. The hope is that over the coming years, more jurisdictions will enact laws similar to those in Singapore or the UK, creating a critical mass of countries where electronic bills of lading and smart contractual performance are recognized across borders. Additionally, inter-governmental dialogues, such as the G20 work and bilateral agreements, may yield principles or best practices that align regulatory approaches to crypto-assets, reducing the current gulf (for example, between the EU's permissive but regulated environment and India's restrictive stance). The *Basel Committee on Banking Supervision* (under the BIS) has set out prudential standards for banks' crypto-asset exposures[256]; while technical, this also encourages jurisdictions to ensure legal clarity so banks can comply, indirectly pressing lawmakers to act.

4.7 Conclusion of Comparative Analysis:

To synthesize the comparative analysis across jurisdictions, the following thematic summary captures how each legal system currently addresses key legal dimensions of blockchain-enabled trade:

1. Smart Contract Recognition

- **United States**: No single federal law, but smart contracts are generally enforceable under the E-SIGN Act and Uniform Electronic Transactions Act.

[256] Basel Committee on Banking Supervision, *Prudential Treatment of Cryptoasset Exposures* (Dec. 2022), https://www.bis.org/bcbs/publ/d545.pdf.

Some states (e.g., Arizona, Tennessee) have explicitly recognized smart contracts in legislation.

- **European Union**: Smart contracts are recognized under general civil law principles. The EU's Data Act - Regulation (EU) 2023/2854—entered into force on 11 January 2024 and will become applicable on 12 September 2025. This regulation introduces specific provisions for the regulation of smart contracts in data-sharing contexts, particularly outlined in Article 30. These provisions set out essential requirements for smart contracts used in the automated execution of data-sharing agreements, including robustness, safe termination, data archiving, and access control mechanisms. While the Data Act does not directly address smart contracts in the context of trade in goods, it marks a significant step in the EU's recognition and regulation of smart contracts within its legal framework.

- **Singapore**: Smart contracts are recognized under the Electronic Transactions Act. Courts have upheld their validity in cases such as *B2C2 Ltd v. Quoine Pte Ltd*, treating them as standard enforceable contracts.

- **India**: No specific legal provision. Enforceability is subject to general contract law principles. Recognition remains uncertain, though the Supreme Court in *Internet and Mobile Association of India v. Reserve Bank of India*, (2020)[257], struck down the RBI's banking ban on crypto, affirming the right to engage in crypto-related commercial activities.

2. Cryptocurrency as Payment in Trade

- **United States**: Crypto is not legal tender but can be used contractually. Taxed as property by the IRS; treated as securities or commodities based on use-case. Subject to AML/FinCEN compliance.

- **European Union**: MiCA regulates crypto-assets and recognizes stablecoins under a licensing regime. Crypto can be contractually used in payment subject to AMLD rules.

[257] Internet & Mobile Ass'n of India v. Reserve Bank of India, (2020) 10 S.C.C. 256 (India).

- **Singapore**: Cryptocurrency is not legal tender but is recognized as a digital asset. Regulated under the Payment Services Act. Tax and regulatory treatment support its use in private international contracts.
- **India**: Crypto is not legal tender. While trade contracts may include crypto payments, they operate in a regulatory grey zone. Recent tax legislation (30% tax and 1% TDS) implies conditional recognition.

3. Regulatory Sandbox or Pro-Innovation Framework

- **United States**: State-level sandboxes (e.g., Arizona, Utah). Federal agencies like the SEC and CFTC issue guidance but no unified innovation framework.
- **European Union**: No official sandbox, but regulatory pilot programs for DLT-based securities and digital finance initiatives.
- **Singapore**: MAS operates a robust regulatory sandbox and innovation hub, actively supporting blockchain-based financial services.
- **India**: RBI and SEBI have launched limited sandboxes. However, blockchain-specific innovation policies are still evolving.

4. Dispute Resolution and Enforcement Mechanisms

- **United States**: Traditional contract law governs. Smart contract disputes may require expert testimony on code interpretation. Arbitration is supported.
- **European Union**: Relies on the Brussels I and Rome I Regulations for jurisdiction and applicable law. National courts are beginning to accept blockchain-related cases.
- **Singapore**: Singapore International Commercial Court and arbitration centers handle blockchain disputes. Courts are technologically informed and legally receptive.
- **India**: Legal enforcement remains under traditional contract doctrine. Lack of precedent on smart contracts or on-chain evidence poses hurdles for dispute resolution.

At present, a company engaging in international trade with a smart contract and cryptocurrency component must navigate an environment of legal diversity. It should carefully choose a governing law that is favorable (perhaps Singapore law or English law, given their clarity on crypto and contracts), include arbitration clauses for dispute resolution, and ensure compliance with each relevant jurisdiction's regulatory requirements (licensing, sanctions, export/import controls, taxation). The comparative review shows that legal reform is actively catching up with technology: the EU and Singapore provide models of integrating new technology into existing legal and trade frameworks, the US demonstrates the adaptability of common-law and multi-agency regulation, and India exemplifies the dilemmas of emerging economies in balancing innovation with control. The trajectory across all jurisdictions is moving toward greater clarity. Each jurisdiction examined is, in its own way, contributing to the developing lexicon and jurisprudence of blockchain and trade: whether through pioneering legislation, case law, or cautious experiments. In the absence of a universal treaty, these domestic legal developments form the patchwork that international traders must piece together in any given transaction. Practitioners and scholars argue that continued international cooperation is needed to avoid a scenario where blockchain's potential efficiency gains are undermined by legal uncertainty and incompatible national laws.[258] As we move forward, the trends suggest an eventual convergence toward commonly accepted principles – for example, that crypto-assets are property, that smart contracts can be legally binding, that parties can choose law and forum for their blockchain transactions, and that there are baseline regulatory safeguards against crime and systemic risk. Achieving this convergence will be key to unlocking the full promise of smart contracts and cryptocurrency in global commerce.

Among the jurisdictions studied, Singapore offers the most coherent legal model for blockchain-based international trade, balancing technological flexibility with statutory certainty. Its legislative embrace of UNCITRAL's MLETR and Payment Services Act regime demonstrates how national law can be modernized to both recognize smart contracts and legitimize crypto-assets within existing trade structures.[259] In contrast,

[258] *See, e.g.*, Konard S. Graf, *Lex Cryptographia: Cryptographic Protocols as Law*, 1 J. L. & Int'l Aff. 117, 142–45 (2015); WTO, *Blockchain & DLT in Trade: Where Do We Stand?* 39–40 (2022), https://www.wto.org/english/res_e/booksp_e/blockchainanddlt_e.pdf

[259] Electronic Transactions (Amendment) Act 2021 (Sing.), https://sso.agc.gov.sg/Acts-Supp/5-2021; Payment Services Act 2019 (Sing.), https://sso.agc.gov.sg/act/psa2019; UNCITRAL, Model Law on

while the EU's MiCA framework, now fully applicable since December 2024, is regulatory-forward, its effectiveness remains limited by its financial-market focus and insufficient treatment of decentralized protocols.[260] The U.S. legal model, marked by common law adaptability and state-level experimentation, presents valuable lessons on organic regulatory evolution but suffers from intra-jurisdictional inconsistency, which limits its utility as a global benchmark.[261] Meanwhile, India's legal inertia, despite judicial interventions and tax policy adaptations, underscores the risk of over-regulating before legislating.[262] These comparisons reveal that the optimal legal approach lies not in uniformity, but in compatibility—where states adopt technology-neutral, principle-based laws that ensure enforceability, transparency, and choice of law while accommodating innovation. The feasibility of international harmonization rests not on a single treaty, but on the convergence of national frameworks around shared pillars such as the recognition of crypto-assets as property, smart contracts as enforceable agreements, and blockchain records as admissible evidence.[263] This chapter reaffirms the dissertation's core hypothesis that doctrinal clarity and cross-border legal interoperability are prerequisites for leveraging blockchain's full potential in trade. Without coordinated reforms and interoperable legal standards, the efficiencies promised by decentralized technologies risk being undermined by regulatory fragmentation and forum uncertainty.

Building on this comparative analysis, the next chapter puts forward targeted legal and policy reform proposals to address the doctrinal and institutional challenges discussed so far. Emphasis is placed on the development of harmonized legal models, the role of international organizations such as UNCITRAL and FATF, and the specific needs and strategies of India and other Global South jurisdictions in adopting blockchain-based trade solutions.

Electronic Transferable Records, U.N. Doc. A/72/17 (2017), https://uncitral.un.org/sites/uncitral.un.org/files/media-documents/uncitral/en/mletr_ebook_e.pdf.

[260] Regulation 2023/1114, 2023 O.J. (L 150) 40 (EU) (Markets in Crypto-Assets Regulation); Dirk A. Zetzsche et al., The Markets in Crypto-Assets Regulation (MiCA) and the EU Digital Finance Strategy: A Conceptual and Legal Critique, 57 Tex. Int'l L.J. 1, 25–27 (2022).

[261] U.C.C. § 12-105 cmt. 2 (Amended 2022); Chris Brummer & Yesha Yadav, Fintech and the Innovation Trilemma, 107 Geo. L.J. 235, 278–79 (2019).

[262] Internet and Mobile Ass'n of India v. RBI, (2020) 10 SCC 274; Pratik Datta, Lawless Contracts: Crypto and the Problem of Enforceability in India, 5 Indian J.L. & Tech. Pol'y 23, 34–36 (2023).

[263] Hague Conf. on Private Int'l Law, The Hague Principles on the Choice of Law in International Commercial Contracts (2015). https://assets.hcch.net/docs/5da3ed47-f54d-4c43-aaef-5eafc7c1f2a1.pdf; UNCITRAL, Model Law on Electronic Commerce (1996), U.N. Doc. A/RES/51/162.

CHAPTER 5

POLICY REFORM PROPOSALS FOR HARMONIZING SMART CONTRACT AND CRYPTO TRADE LAWS

5.1 Introduction

Chapter 5 turns to prescriptive solutions, building on Chapter 3's doctrinal analysis and the comparative insights of Chapter 4. As those chapters showed, the legal landscape for blockchain-based smart contracts and cryptocurrency in international trade remains fragmented and inconsistent across jurisdictions, creating uncertainty for transacting parties.[264] Businesses and individuals must follow a complex patchwork of laws and regulations based on where they operate. International trade transactions that utilize decentralized technology confront unsettled questions of contract enforceability, applicable law, regulatory compliance, and dispute resolution on a cross-border scale. The absence of a harmonized framework has led to gaps that undermine both legal certainty and the efficiency gains that these technologies promise.[265]

This chapter proposes a forward-looking policy framework to harmonize smart contract and crypto-asset laws in the cross-border trade context. Section 5.2 begins by identifying key legal and regulatory gaps highlighted by prior chapters – from the lack of smart contract recognition and uniform crypto-asset classification to conflicts in jurisdictional rules and evidentiary uncertainties. Section 5.3 then offers international reform proposals addressing these gaps. It advocates for harmonization measures in four specific domains: (i) formal recognition of smart contracts as legally enforceable agreements, (ii) mechanisms to ensure cross-border enforceability of blockchain transactions (including clearer private international law rules), (iii) a common taxonomy and regulatory treatment for crypto-assets, and (iv) updated evidentiary standards for digital records like blockchains. Section 5.4 discusses the institutional roles of key multilateral bodies – UNCITRAL, FATF, the WTO, and the BIS – in facilitating these reforms. Section 5.5 provides targeted recommendations for India and

[264] World Trade Organization, Can Blockchain Revolutionize International Trade?, WTO Staff Working Paper ERSD-2018-10, at 4–5 (2018), https://www.wto.org/english/res_e/booksp_e/blockchainrev18_e.pdf (last visited April 07, 2025).
[265] Int'l Monetary Fund & Fin. Stability Bd., IMF-FSB Synthesis Paper: Policies for Crypto-Assets (Sept. 2023), https://www.fsb.org/uploads/R070923-1.pdf (last visited April 07, 2025).

other Global South countries, emphasizing capacity-building and calibrated adoption of global standards to suit emerging economy contexts. Finally, Section 5.6 concludes by synthesizing how these proposals can address the identified challenges and pave the way for the dissertation's overall conclusions on blockchain's legal future in trade.

The tone of analysis remains academic and critical. Each major assertion is buttressed by authority: footnotes document current laws, model laws, international guidelines, and scholarly commentary in Bluebook-compliant format. Through this rigorous approach, Chapter 5 aims to articulate a cohesive set of policy reforms that respond to the doctrinal and practical gaps identified, thereby fostering a more predictable and enabling legal environment for blockchain and cryptocurrency in international commerce.

5.2 Identification of Key Legal and Regulatory Gaps

Before formulating reforms, it is essential to pinpoint the principal legal and regulatory gaps that currently impede the integration of smart contracts and crypto-assets into international trade. Chapters 3 and 4 revealed several critical problem areas that any harmonization effort must address:

- **Fragmented Regulatory Regimes and Definitions:** There is no universally accepted legal status for cryptocurrencies or smart contracts in trade. National approaches diverge sharply, ranging from jurisdictions with enabling regimes to those with restrictive or prohibitive stances. Some countries (for example, the EU under its new MiCA regulation, or Singapore under its Payment Services Act) have embraced crypto-assets with bespoke licensing and clear definitions, whereas others (like China and Nigeria) have banned or heavily constrained crypto use.[266] This regulatory fragmentation means that a crypto-asset might be treated as a security in one country, a commodity or property in another, or have no legal recognition in a third. The lack of harmonized classification leads to regulatory arbitrage and inconsistent compliance obligations, undermining legal certainty for

[266] Robert W. Gaines, *Cryptocurrency: An Overview of Global, Regional and National Regulations*, PKF O'Connor Davies, at 1 (Sept. 2023), https://www.pkfod.com/wp-content/uploads/2023/09/Cryptocurrency-An-Overview-of-Global-Regional-and-National-Regulations-2.pdf (last visited April 07, 2025).

cross-border transactions.[267] Businesses engaging in crypto-enabled trade face duplicative or conflicting rules across jurisdictions, increasing transaction costs and legal risk.[268]

- **Unclear Legal Recognition and Enforceability of Smart Contracts:** Smart contracts – self-executing agreements in code – do not always fit neatly into traditional contract law doctrines. While electronic transactions laws (like the U.S. E-SIGN Act and state Uniform Electronic Transactions Acts) establish that electronic signatures and records cannot be denied legal effect solely due to their form, the application of these principles to autonomous code-based performance is not uniformly settled.[269] Some jurisdictions or states have proactively amended laws to recognize blockchain-based contracts (e.g., Arizona's 2017 law declaring that a contract containing a smart contract term cannot be denied validity solely for that reason)[270], but many countries have no explicit provision.[271] This yields uncertainty about contract formation, interpretation, and remedies for smart contracts. For instance, courts may struggle to apply concepts like offer and acceptance, mistake, or force majeure to agreements effectuated entirely by code without natural-language recitals. Civil-law and common-law systems also differ in recognizing digital or implicit consent, complicating cross-border enforceability. Without clear recognition, parties to a blockchain-based trade may face arguments that their "smart contract" is not a legally binding contract at all, or that it lacks an applicable legal framework for issues like breach or termination.[272]

- **Jurisdictional Uncertainty and Conflict-of-Law Issues:** The decentralized, borderless nature of blockchain transactions challenges conventional private international law rules. Traditional tests for jurisdiction and applicable law (such as the place of contracting, place of performance, or domicile of parties) become difficult to apply when dealings occur via distributed ledger with no geographic

[267] Int'l Monetary Fund & Fin. Stability Bd., IMF-FSB Synthesis Paper: Policies for Crypto-Assets, at 5–6 (Sept. 2023), https://www.fsb.org/uploads/R070923-1.pdf (last visited April 12, 2025).
[268] Robert W. Gaines, *Cryptocurrency: An Overview of Global, Regional and National Regulations*, PKF O'Connor Davies 1 (Sept. 2023), https://www.pkfod.com/wp-content/uploads/2023/09/Cryptocurrency-An-Overview-of-Global-Regional-and-National-Regulations-2.pdf (last visited April 12, 2025).
[269] 15 U.S.C. § 7001(a) (2000); Uniform Electronic Transactions Act § 7(a), *U.L.A.* (1999).
[270] Ariz. Rev. Stat. Ann. § 44-7061 (2017); Tenn. Code Ann. § 47-10-202 (2018).
[271] UNCITRAL Secretariat, *Legal Issues Related to Smart Contracts and Distributed Ledger Technology*, U.N. Doc. A/CN.9/1012, ¶ 15 (2022).
[272] Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* 69–75 (Harvard Univ. Press 2018).

center. In cross-border trade, it may be unclear which country's courts have authority to resolve a dispute arising from a smart contract, or which country's law governs the rights and obligations encoded in self-executing transactions.[273] For example, a cargo sale executed via a blockchain escrow might involve a buyer in country A, seller in country B, and nodes validating the transaction globally – leaving ambiguity over where the contract was "made" or performed. The lex loci contractus doctrine loses traction when the "location" of contract formation is virtual.[274] Similarly, assets recorded on a blockchain do not have an obvious situs for the purpose of property law or security interests. As the Law Commission of England and Wales observes, emerging technologies like crypto-tokens "add novel and arguably intractable problems" to conflict-of-law analysis by undermining the territorial assumptions of existing rules.[275] The result is a gap in cross-border enforceability: parties cannot readily predict which law or forum will apply, and judgements or arbitral awards may face obstacles at the recognition/enforcement stage if the underlying legal status of the asset or contract is contested across jurisdictions.

- **Anti-Money Laundering (AML) and Regulatory Compliance Gaps:** Blockchain-based trade transactions, especially those using cryptocurrencies for payments, raise heightened AML/KYC concerns. Chapter 3 detailed how anonymity features, peer-to-peer transfers, and the absence of intermediaries can allow circumvention of traditional compliance controls. While the Financial Action Task Force (FATF) has updated its global standards (applying the Travel Rule and other AML/CFT measures to virtual asset service providers), implementation by states has been uneven and slow.[276] As of 2022, FATF found that only 29 out of 98 surveyed jurisdictions had passed Travel Rule legislation,

[273] UNIDROIT, Principles on Digital Assets and Private Law, Principle 6 (2023), https://www.unidroit.org/wp-content/uploads/2024/01/Principles-on-Digital-Assets-and-Private-Law-linked-1.pdf (last visited April 12, 2025).
[274] Ugo Pagallo*, Lex Cryptographia: The Legal Infrastructure of Blockchain,* 31 Philosophy & Technology 305–323 (2018), https://doi.org/10.1007/s13347-018-0323-5 (last visited April 12, 2025).
[275] Law Commission of England and Wales, *Digital Assets: Consultation Paper*, Consultation Paper No. 256, ¶¶ 7.48–7.59 (2022), https://service.betterregulation.com/sites/default/files/2022-07/Digital-Assets-Consultation-Paper-Law-Commission-1.pdf (last visited April 12, 2025).
[276] Fin. Action Task Force, *Updated Guidance for a Risk-Based Approach: Virtual Assets and Virtual Asset Service Providers* 3–5 (Oct. 2021), https://www.fatf-gafi.org/media/fatf/documents/recommendations/Updated-Guidance-VA-VASP.pdf (last visited April 12, 2025).

and even fewer had begun enforcement of these requirements.[277] This patchy adoption creates loopholes: illicit actors can exploit jurisdictions with lax or no crypto AML rules, and compliant businesses face an unlevel playing field. In cross-border trade, a shipment paid via cryptocurrency might trigger different reporting or customer due-diligence duties depending on each country's rules – or risk falling between the cracks of multiple jurisdictions. The lack of a coordinated approach to crypto compliance not only undermines enforcement against financial crime, but also burdens legitimate commerce with legal uncertainty about acceptable practices.

- **Evidentiary and Procedural Challenges:** Another gap lies in how legal systems treat blockchain records and algorithmic outputs within judicial or arbitral proceedings. Smart contracts and digital assets generate digital evidence (transaction histories, cryptographic signatures, timestamped records) that do not fit neatly into traditional evidence law categories. Many jurisdictions still require authenticated documentary evidence or witness testimony to establish facts – standards developed for paper and human communications. Blockchain records, by contrast, are tamper-resistant and timestamped by design, but courts must be satisfied of their authenticity and integrity. In the absence of clear rules, litigants face uncertainty whether a blockchain transaction record will be accepted as self-authenticating (akin to a notarized document or business record) or whether a foundation witness is needed to explain the technology. Some leading jurisdictions have begun to address this: for example, Vermont enacted a statute providing that blockchain records accompanied by a sworn certification are presumptively authentic and admissible, even overcoming hearsay objections in evidence[278]. Likewise, China's Supreme People's Court issued regulations in 2018 confirming that internet courts shall recognize the legality of blockchain data as evidence if certain conditions of reliability are met[279].

[277] Fin. Action Task Force, Targeted Update on Implementation of the FATF Standards on Virtual Assets and Virtual Asset Service Providers, FATF Report, at 2 (June 2022), https://www.fatf-gafi.org/content/dam/fatf-gafi/recommendations/2024-Targeted-Update-VA-VASP.pdf.coredownload.inline.pdf.
[278] Vt. Stat. Ann. tit. 12, § 1913 (2018).
[279] Supreme People's Court (China), Provisions on Several Issues Related to the Trial of Cases by the Internet Courts (Sept. 7, 2018) (trans. China Law Translate), https://www.chinalawtranslate.com/en/the-supreme-peoples-courts-provisions-on-several-issues-related-to-trial-of-cases-by-the-internet-courts/ (last visited April 29, 2025); Wolfie Zhao, *China's Supreme Court Recognizes Blockchain Evidence as Legally Binding*, Coindesk (Sept. 7, 2018; updated Sept. 13, 2018),

However, many countries lack explicit provisions, meaning evidentiary treatment of blockchain-based proof is left to judges' discretion. This creates a risk of inconsistent outcomes – a smart contract's audit trail might be readily accepted as evidence in one forum but deemed insufficient in another. Without harmonized evidentiary standards, enforcement of rights in crypto-related trade disputes (whether in court or arbitration) remains less predictable and more costly.

- **Lack of Tailored Dispute Resolution Mechanisms:** Finally, there is a gap in effective dispute resolution avenues for blockchain commerce. Chapter 3 noted that while smart contracts aim to be self-enforcing, disputes can still arise (for instance, over whether code executed as intended, or how to address unforeseen events). Traditional litigation or arbitration may prove ill-suited due to technical complexity and the cross-border, pseudonymous nature of parties.[280] Novel solutions like on-chain arbitration or decentralized dispute resolution have been proposed, but they raise questions about enforceability and due process.[281] At present, no widely adopted mechanism exists to seamlessly resolve disputes stemming from smart contracts that operate across jurisdictions.[282] This procedural gap means that if a conflict occurs – say, a party claims a smart contract outcome was triggered by fraud or code error – there is uncertainty about how and where the issue can be adjudicated and how any decision can be enforced (especially if one party remains anonymous or assets are held in smart contracts).[283] The lack of multilateral frameworks for resolving blockchain disputes compounds the substantive legal gaps noted above, further chilling parties' confidence in using these technologies for international deals.

In summary, the integration of blockchain and crypto in international trade is hindered by significant gaps in law and regulation. These gaps span both *private law* (contract formation, property rights, conflict-of-laws) and *regulatory law* (financial regulation,

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https://www.coindesk.com/markets/2018/09/07/chinas-supreme-court-recognizes-blockchain-evidence-as-legally-binding/ (last visited April 29, 2025).

[280] Joshua Fairfield, *Smart Contracts, Bitcoin Bots, and Consumer Protection*, 71 Wash. & Lee L. Rev. 35, 83–87 (2014), https://scholarlycommons.law.wlu.edu/cgi/viewcontent.cgi?article=1003&context=wlulr-online.

[281] *Id.*

[282] Gary Born, *International Commercial Arbitration*, Vol. 1, ch. 6 (3d ed. 2021).

[283] *Id*

AML/KYC), as well as procedural domains (evidence and dispute resolution). The combined effect, as documented, is a climate of uncertainty that can deter mainstream adoption and complicate cross-border commerce. The next sections propose reforms targeted at each of these problem areas, aiming to harmonize and modernize the legal framework so that it supports innovation while safeguarding legal and economic interests.

5.3 International Policy Reform Proposals

Achieving harmonization in such a complex field requires a multifaceted strategy. This section advances a set of international policy reform proposals corresponding to the gaps identified. These proposals are rooted in emerging best practices and model frameworks, seeking to align national laws with common principles. The focus is on crafting solutions that can be adopted across jurisdictions – whether through formal treaties, model laws, soft-law principles, or coordinated national reforms – to foster a more uniform and certain legal environment for smart contracts and crypto-assets in trade. Four priority areas are addressed in turn: (1) recognition of smart contracts as enforceable agreements, (2) cross-border enforceability mechanisms and conflict-of-law rules, (3) a harmonized taxonomy and regulatory approach for crypto-assets, and (4) standardized evidentiary rules for blockchain-based evidence. Each proposal draws on international experience and expert recommendations, underscoring how law reform can balance innovation with risk mitigation.

5.3.1 Harmonization of Smart Contract Recognition

Proposal: Countries should collectively recognize smart contracts as valid and enforceable instruments under contract law, through either a multilateral model law or coordinated domestic reforms, thereby removing ambiguity about the legal effect of code-based agreements. The goal is to ensure that an agreement formed via a smart contract – such as an automated payment against delivery obligation on a blockchain – is not denied legal effect *solely* because of its technological form.[284] This reform can build on existing electronic transactions laws, clarifying that the use of programmatic code to execute obligations satisfies requirements of writing, signature, and intent to form a contract, provided the parties so agreed.

[284] United Nations Comm'n on Int'l Trade Law (UNCITRAL), *Model Law on Electronic Commerce*, art. 5 bis (1996) file:///C:/Users/acer/Downloads/19-04970_ebook%20(2).pdf (last visited April 12, 2025).

Rationale and Details: The concept that a contract should not be discriminated against for being in electronic form is already well entrenched in instruments such as the UNCITRAL Model Law on Electronic Commerce (1996)[285] and the United Nations Convention on the Use of Electronic Communications in International Contracts (2005)[286]. However, those instruments predated the advent of decentralized blockchain contracts and may not explicitly account for self-executing code. The reform proposal is to update and extend such principles to smart contracts. In July 2024, UNCITRAL took a significant step by adopting the Model Law on Automated Contracting (MLAC)[287], which expressly addresses contracts concluded and performed by automated systems (including "smart contracts"). The MLAC provides a uniform legal framework confirming that contracts formed by the interaction of algorithmic agents have the same validity as traditional agreements, and it offers guidance on issues like attribution of actions to the parties and error handling in automated transactions. Countries should consider enacting this Model Law or similar provisions. Doing so would harmonize recognition of smart contracts globally and fill the current doctrinal uncertainty.

Notably, the Model Law approach complements existing e-commerce laws rather than replacing them. It affirms that if a jurisdiction has laws based on UNCITRAL texts (as over 100 do, per UNCITRAL's report), those laws should be interpreted to cover blockchain-based dealings[288]. For example, just as the UN Electronic Communications Convention[289] ensures a contract isn't denied effect due to being electronic, the new Model Law ensures a contract isn't denied effect *because performance is automated by code*.[290] Key elements to harmonize include: definitions of "smart contract" or "automated contract" in law, recognition that a person's intent can be expressed via deploying code, and rules for how to interpret the code in case of dispute (e.g.

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[285] *Id*

[286] United Nations Convention on the Use of Electronic Communications in International Contracts, art. 9, Apr. 6, 2005, 2898 U.N.T.S. 3, https://treaties.un.org/doc/source/RecentTexts/X-18_english.pdf (last visited April 12, 2025).

[287] U.N. Comm'n on Int'l Trade Law, *Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited April 15, 2025).

[288] United Nations Comm'n on Int'l Trade Law, *Status: UNCITRAL Model Law on Electronic Commerce (1996)*, file:///C:/Users/acer/Downloads/19-04970_ebook%20(2).pdf (last visited April 15, 2025).

[289] United Nations Convention on the Use of Electronic Communications in International Contracts, art. 9, Apr. 6, 2005, 2898 U.N.T.S. 3, https://treaties.un.org/doc/source/RecentTexts/X-18_english.pdf (last visited April 15, 2025).

[290] U.N. Comm'n on Int'l Trade Law, *Model Law on Automated Contracting*, art. 3, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited April 15, 2025).

preferring any natural-language contract terms the parties provided, or resorting to the code's functionality if that was the sole expression of the agreement). Jurisdictions that have already updated domestic laws illustrate the feasibility: e.g., Arizona's amendment to its Electronic Transactions Act explicitly validates blockchain-based signatures, records, and smart contract terms[291]. Other U.S. states (Tennessee, Wyoming) and countries like *Italy* (which in 2019 legislated that smart contracts satisfying certain technical standards have legal validity for performance of a contract) have taken similar steps.[292] A coordinated international initiative would encourage all jurisdictions to follow suit, thus eliminating the patchwork where a smart contract might be enforceable in one jurisdiction but viewed skeptically in another.

Additionally, harmonization should address contract interpretation and consumer protection in smart contracts. One concern is that code may execute in ways that are unexpected or harsh under traditional contract doctrines (e.g., no concept of force majeure in code)[293]. A policy solution is to encourage jurisdictions to adopt *model guidelines or principles* for interpreting smart contracts, perhaps via an UNCITRAL guidance document or an annex to the model law. For instance, the law could provide that where a smart contract's outcome is challenged, courts may consider external evidence of the parties' intent and apply equitable doctrines (like mistake or frustration) notwithstanding the automatic execution.[294] This ensures smart contracts are integrated into the legal system's protective measures rather than existing in a lawless space. By formally recognizing smart contracts and providing interpretive guardrails, the international community can promote innovation (parties can rely on code automating performance) while preserving fairness and contractual stability.

Implementation Pathways: The primary pathway is through UNCITRAL's work – the MLAC 2024[295] is an ideal template for nations to adopt or adapt. UNCITRAL could also develop a *Guide to Enactment* providing examples and addressing cross-border

[291] Ariz. Rev. Stat. Ann. § 44-7061 (2017); Tenn. Code Ann. § 47-10-202 (2018).
[292] Decreto-Legge 14 dicembre 2018, n. 135, art. 8-ter, converted into law by Legge 11 febbraio 2019, n. 12 (Italy), https://www.gazzettaufficiale.it/eli/id/2018/12/14/18G00163/SG (last visited April 21, 2025).
[293] Ewan McKendrick, *Contract Law* 197–215 (14th ed. 2021).
[294] U.N. Comm'n on Int'l Trade Law, *Model Law on Automated Contracting*, ¶¶ 63–67 U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited April 21, 2025).
[295] U.N. Comm'n on Int'l Trade Law, *Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited April 21, 2025).

scenarios. In parallel, bodies like the G20 or OECD could endorse the principle of smart contract recognition to spur legislative updates. Within trade agreements, clauses could be introduced to commit parties to honoring electronic contracts and not denying enforcement to smart contract-based obligations (similar to how the USMCA and other digital trade agreements commit to recognizing electronic signatures and documents)[296]. At a minimum, mutual recognition could be advanced: states might agree that a smart contract valid under the law of one party will be respected by the others. Over time, as more jurisdictions adopt compatible rules, the legal effect of smart contracts would be broadly consistent, reducing uncertainty for cross-border trade participants.

5.3.2 Cross-Border Enforceability and Private International Law Reforms

Proposal: Develop a set of private international law rules or principles tailored to digital transactions, to ensure that cross-border blockchain and crypto-asset contracts are subject to clear jurisdiction and choice-of-law frameworks. This could take the form of a new international instrument – for example, Hague Conference principles on conflict of laws for digital assets and smart contracts – or coordinated law reforms that establish connecting factors for blockchain-based commerce.[297][298] The objectives are to: (1) clarify which country's law governs a blockchain transaction in the absence of party agreement, (2) enable parties to choose applicable law and forum for disputes with legal certainty, and (3) facilitate recognition of judgments or arbitral awards relating to crypto-assets across borders.

Rationale and Details: As noted, the borderless nature of distributed ledger transactions currently leaves a vacuum in traditional conflict-of-law analysis. To address this, the international legal community should extend existing private international law frameworks to explicitly cover digital assets and contracts. One approach is to leverage the Hague Conference on Private International Law's (HCCH) operations. The HCCH has experience in establishing choice-of-law principles for

[296] Agreement Between the United States of America, the United Mexican States, and Canada, art. 19.5, July 1, 2020, https://ustr.gov/trade-agreements/free-trade-agreements/united-states-mexico-canada-agreement/agreement-between (last visited April 26, 2025).
[297] Hague Conference on Private International Law, *Principles on Choice of Law in International Commercial Contracts* arts. 1–3 (2015), https://www.hcch.net/en/instruments/conventions/full-text/?cid=135 (last visited April 21, 2025).
[298] Hague Conference on Private International Law, *Legal Certainty for Digital Assets and Distributed Ledger Technology: Proposal for Future Work* (May 2022), https://assets.hcch.net/docs/f47eb0a7-dc9e-468f-8998-4f015fdc4582.pdf.

international commercial contracts (e.g., the 2015 Hague Principles on Choice of Law) and for specific asset types (e.g., the Hague Securities Convention for intermediated securities). A logical next step would be a Hague project focusing on *crypto-assets and decentralized contracts*. Indeed, UNIDROIT – another international body – has recently finalized Principles on Digital Assets and Private Law (2023), which include guidance on determining the law applicable to proprietary issues in digital assets[299]. Those principles suggest using factors like the law of the issuer's location for certain crypto-assets or the law chosen in system rules, but they are non-binding. Building on such work, states could negotiate more concrete rules.

Key points for harmonization include:

- **Party Autonomy:** Parties to an international smart contract should have the freedom to choose the governing law and dispute forum (court or arbitration tribunal) for their contract, and such choice should be given effect globally just as in traditional contracts.[300] Many legal systems already uphold contractual choice-of-law; the reform is to affirm that this principle is equally applicable when the contract is recorded and executed on a blockchain. For example, if a supply agreement is embodied in a smart contract, a choice of the law of England and choice of ICC arbitration should be recognized even if the performance is through a decentralized network.[301]

- **Default Applicable Law:** In the absence of an express choice by the parties, new rules should define how to find the law with the closest connection to a blockchain transaction. Traditional connecting factors (place of contracting, place of performance, location of subject matter) may not directly work. Possible criteria could be the place of business of the party with the primary performance, or the place where a central coordinating agent is located (if one

[299] UNIDROIT, *Principles on Digital Assets and Private Law* (2023), https://www.unidroit.org/wp-content/uploads/2024/01/Principles-on-Digital-Assets-and-Private-Law-linked-1.pdf (last visited April 21, 2025).
[300] See Hague Conference on Private International Law, *Principles on Choice of Law in International Commercial Contracts*, arts. 1–2 (2015), https://www.hcch.net/en/instruments/conventions/full-text/?cid=135 (last visited April 21, 2025).
[301] See Int'l Chamber of Com., *ICC Arbitration Rules* art. 18 (2021), https://iccwbo.org/wp-content/uploads/sites/3/2020/12/icc-2021-arbitration-rules-2014-mediation-rules-english-version.pdf (last visited April 26, 2025).

exists, such as an operator of a blockchain platform used by the parties).[302] Another innovative idea is to recognize the concept of the "location" of a digital asset or contract by reference to the law of the jurisdiction that the system or parties have some nexus to – for instance, the law under which an on-chain token is issued or the law tied to an oracle or intermediary. The UK Law Commission, as part of its Digital Assets Law Reform Project (2022–2024), studied how to adapt private international law rules to crypto-tokens and electronic trade documents. The Commission acknowledged that determining the legal "location" of digital assets is inherently complex and may require statutory reform.[303] Any emerging recommendations from such national efforts (e.g., suggesting that a crypto asset could be treated as located at the owner's place of habitual residence or principal place of business) should be coordinated internationally so that all jurisdictions apply similar rules.

- **Jurisdiction and Enforcement:** Alongside choice-of-law, jurisdictional rules need adaptation. Parties should be able to expressly agree on dispute resolution fora (courts or arbitration) in smart contract deals, and such agreements should be respected (much as arbitration clauses and forum selection clauses are generally upheld by instruments like the New York Convention 1958 for arbitral awards and the Hague Choice of Court Convention 2005)[304][305]. In the absence of agreement, clear default rules are needed. These might tie jurisdiction to the defendant's domicile or the place of the claimant's domicile in certain digital contexts, or allow jurisdiction where a significant part of the activity occurred (even if virtually). Because blockchain transactions may involve pseudonymous parties, special provision could be made for effective notice and service (for example, allowing notice via the electronic address or platform used, if traditional means are unavailable). Once a judgment or award is rendered, its enforcement should not be defeated simply due to the digital nature of the asset;

[302] See Hague Conf. on Priv. Int'l L., *Legal Certainty for Digital Assets and Distributed Ledger Technology: Proposal for Future Work* (May 2022), https://assets.hcch.net/docs/f47eb0a7-dc9e-468f-8998-4f015fdc4582.pdf.
[303] See U.K. Law Comm'n, *Digital Assets: Consultation Paper*, Consultation Paper No. 256, ¶¶ 7.48–7.59 (2022), https://webarchive.nationalarchives.gov.uk/ukgwa/20250109093910mp_/https://cloud-platform-e218f50a4812967ba1215eaecede923f.s3.amazonaws.com/uploads/sites/30/2022/07/Digital-Assets-Consultation-Paper-Law-Commission-1.pdf (last visited April 26, 2025).
[304] See Convention on the Recognition and Enforcement of Foreign Arbitral Awards art. III, June 10, 1958, 330 U.N.T.S. 38.
[305] See Hague Convention on Choice of Court Agreements art. 5, June 30, 2005, 44 I.L.M. 1294.

courts should be guided to treat crypto-assets as property that can be subject to enforcement (such as freezing orders or execution orders), and cooperating jurisdictions should recognize those orders.[306]

To facilitate this, it may be worth considering a protocol under existing frameworks: e.g., an extension of the *New York Convention* or future Hague instruments to explicitly include disputes involving crypto-assets. The absence of precedents here means international dialogue is crucial. Arbitral institutions have begun tailoring rules for blockchain disputes (for instance, specialized arbitration rules for smart contracts have been proposed by certain industry groups), and these could be integrated by reference.[307]

Implementation Pathways: A likely path is via soft law principles first, then hard law. The HCCH[308] or UNIDROIT[309] could promulgate principles on conflict of laws in digital assets, building consensus that could later crystallize into a binding convention. Concurrently, national legislatures (especially in leading commercial hubs) should update their private international law statutes. For example, they could amend definitions of "location" or "situs" in property and insolvency laws to cover digital assets, and clarify how to handle jurisdiction when a defendant is effectively "locationless" in cyberspace. Another avenue is trade agreements: trade agreements increasingly contain *digital trade chapters*, which might include commitments on electronic transactions and cooperation in legal frameworks. A plurilateral agreement (perhaps within the WTO's Joint Statement Initiative on E-Commerce or under regional blocs) could commit signatories to adopt compatible conflict-of-law rules for digital trade and to not discriminate against blockchain-based legal claims.[310] Over time, as these norms diffuse, a litigant in any member country would know that, for instance,

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[306] **U**.K. Jurisdiction Taskforce, *Legal Statement on Cryptoassets and Smart Contracts* (2019), ¶¶ 22–38, https://technation.io/wp-content/uploads/2019/11/6.6056_JO_Cryptocurrencies_Statement_FINAL_WEB_111119-1.pdf.

[307] See CodeLegit, *Arbitration Rules for Blockchain Disputes* (2018).

[308] See Hague Conf. on Priv. Int'l L., *Legal Certainty for Digital Assets and Distributed Ledger Technology: Proposal for Future Work* (May 2022), https://assets.hcch.net/docs/f47eb0a7-dc9e-468f-8998-4f015fdc4582.pdf.

[309] See UNIDROIT, *Principles on Digital Assets and Private Law* (2023), https://www.unidroit.org/wp-content/uploads/2024/01/Principles-on-Digital-Assets-and-Private-Law-linked-1.pdf (last visited May 18, 2025).

[310] See World Trade Org., *Joint Statement on Electronic Commerce* (Jan. 25, 2019), WT/L/1056, file:///C:/Users/acer/Downloads/1056%20(1).pdf (last visited May 18, 2025).

their rights in a token or smart contract will be determined under a coherent set of laws rather than an unpredictable grab-bag of forum laws.

In summary, by establishing clear conflict-of-law and jurisdictional rules for blockchain transactions, we remove a major barrier to cross-border enforceability. Parties will gain confidence that their agreements have a definite legal home and that recourse to adjudication is viable if needed, even across national boundaries. This legal infrastructure is the backbone that can support the technological infrastructure of decentralized trade.

5.3.3 Crypto-Asset Classification and Regulatory Harmonization

Proposal: International policymakers should develop a common taxonomy and minimum regulatory standards for crypto-assets, especially as used in trade and finance, to be implemented domestically in a harmonized way. This involves categorizing crypto-assets (e.g. distinguishing payment tokens, utility tokens, security tokens, stablecoins, etc.) and agreeing on their legal treatment (such as whether they are regulated as securities, commodities, currency, property, or a sui generis digital asset).[311] A model law or coordinated regulatory framework – akin to a "global crypto rulebook" – would reduce uncertainty and prevent regulatory arbitrage by aligning definitions and oversight across jurisdictions. It would cover aspects like licensing of crypto service providers, consumer/investor protections, prudential measures for financial institutions dealing with crypto, and the legal status of digital tokens (including ownership rights and negotiability in commerce).

Rationale and Details: As detailed in Chapter 4's comparative analysis, one of the greatest impediments to legal clarity is the inconsistent classification of crypto-assets from country to country.[312] For instance, a token that is considered a security under U.S. SEC jurisdiction might be unregulated in a country that has no securities-law concept of crypto, or treated as a commodity under another country's law. This creates confusion in cross-border trade transactions that use crypto for payment or involve tokenized assets. A company cannot be sure if its token-based financing of a shipment will trigger

[311] See Regulation 2023/1114 of the European Parliament and of the Council of 31 May 2023 on Markets in Crypto-Assets, 2023 O.J. (L 150) 40.
[312] See Int'l Monetary Fund, *How to Build a Comprehensive Policy Framework for Crypto Assets*, at 5 (2023), https://www.imf.org/en/Publications/Staff-Discussion-Notes/Issues/2023/04/12/How-to-Build-a-Framework-for-Crypto-Assets-531967.

securities compliance in one country or money transmission laws in another. The need for a clear classification was highlighted by international bodies in recent years. The International Monetary Fund's guidance in 2023 explicitly calls for providing "a solid legal foundation with a clear classification of crypto assets" as part of any comprehensive regulatory approach. Likewise, the IMF-FSB joint synthesis report (2023)[313] urges jurisdictions to modernize private law to clarify crypto-asset classification and to fill gaps where existing financial law does not adequately cover crypto activities.

An emerging example of harmonization is the European Union's Markets in Crypto-Assets (MiCA) Regulation (2023), which creates an EU-wide taxonomy (defining terms like "crypto-asset," "utility token," "asset-referenced token," and "e-money token") and sets uniform rules for issuers and service providers.[314] MiCA, for instance, requires authorization for crypto-asset service providers and includes disclosure and reserve requirements for stablecoin issuers. By having a single framework across 27 countries, the EU is eliminating intra-EU regulatory arbitrage; a similar approach could be scaled globally through coordination. Other jurisdictions like Japan (which classifies crypto as a form of property value and regulates intermediaries under its Payment Services Act)[315] and Singapore (under its Payment Services Act and forthcoming omnibus legislation)[316] also provide useful models. A global policy reform would encourage aligning these approaches so that, for example, a "stablecoin" is commonly understood and subjected to comparable prudential standards everywhere – preventing a risky stablecoin from shopping for the least stringent jurisdiction to operate out of.

Key elements of the harmonized classification and regulatory framework might include:

[313] See Int'l Monetary Fund & Fin. Stability Bd., *IMF-FSB Synthesis Paper: Policies for Crypto-Assets*, at 6–7 (Sept. 2023), https://www.fsb.org/uploads/R070923-1.pdf (last visited May 18, 2025).
[314] See Regulation 2023/1114 of the European Parliament and of the Council of 31 May 2023 on Markets in Crypto-Assets, 2023 O.J. (L 150) 40.
[315] See Payment Services Act, Act No. 59 of 2009 (Japan), as amended; Japan Fin. Servs. Agency, *Regulatory Approaches to Crypto-Assets* (2022), https://www.fsa.go.jp/en/news/2022.html (last visited May 18, 2025).
[316] See also MAS, *Consultation Paper on Proposed Regulatory Framework for Stablecoin-Related Activities* (2022), https://www.mas.gov.sg/-/media/mas-media-library/publications/consultations/pd/2022/consultation-on-stablecoin-regulatory-approach_finalised.pdf (last visited May 18, 2025).

- **Uniform Definitions:** Agree on standard definitions for major categories: e.g., *Virtual Asset* (as FATF uses the term)[317] versus *Digital Token*, *Security Token*, etc. Agree on what characteristics make a crypto-asset a security/investment contract (perhaps drawing from common principles like the Howey test in the U.S.[318] or the EU's approach in MiCA)[319], versus when it is a utility token or payment token. Also, define terms like "smart contract" in regulatory contexts (not just contract law) to avoid confusion – for instance, distinguishing a smart contract code from a legal contract, sometimes termed "smart legal contract," in legal usage.

- **Property and Ownership Rights:** Acknowledge crypto-assets as a form of property or asset that can be owned, transferred, and encumbered. This is critical for trade finance (e.g., using crypto assets as collateral or payment). Legal systems influenced by common law have begun recognizing crypto as property – the UK courts in cases since *AA v. Persons Unknown* (2019)[320] have treated crypto-assets as property, and the UK Law Commission recommended statutory confirmation of this with the notion of a third category of personal property for digital assets.[321] Harmonization would see all jurisdictions clarifying that owners of crypto-assets have property rights protected by law, which supports remedies like theft claims, security interests, and succession planning.

- **Regulatory Oversight and Licensing:** Set baseline standards for licensing or registering crypto-asset service providers (CASPs or VASPs) such as exchanges, wallet custodians, payment providers. FATF's standards already push for licensing and AML regulation of VASPs, but beyond AML, broader regulatory consistency is needed for market integrity and consumer protection.[322] For example, jurisdictions could agree to require exchanges to segregate client assets,

[317] See Fin. Action Task Force, *Glossary: Virtual Asset*, https://www.fatf-gafi.org/glossary/u-z#Virtual_asset.
[318] See SEC v. W.J. Howey Co., 328 U.S. 293, 298–99 (1946).
[319] See Regulation 2023/1114 of the European Parliament and of the Council of 31 May 2023 on Markets in Crypto-Assets, 2023 O.J. (L 150) 40.
[320] See AA v. Persons Unknown, [2019] EWHC 3556 (Comm).
[321] See U.K. Law Comm'n, *Digital Assets: Final Report* ch. 4 (2023), https://www.skadden.com/-/media/files/publications/2024/09/uk-government-introduces-bill/digitalassetsreport.pdf (last visited May 27, 2025)
[322] See Fin. Action Task Force, *Updated Guidance for a Risk-Based Approach: Virtual Assets and Virtual Asset Service Providers*, at 15–20 (Oct. 2021), https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Updated-Guidance-VA-VASP.pdf.coredownload.inline.pdf (last visited May 27, 2025).

maintain adequate capital, and implement cybersecurity measures. An international framework could be facilitated by IOSCO (International Organization of Securities Commissions) and the Basel Committee: indeed, IOSCO in 2023 proposed policy recommendations for crypto-asset trading platforms aligning with securities regulation principles,[323] and the Basel Committee has issued global bank capital rules for crypto-asset exposures (effective 2025).[324] National regulators implementing these consistently will ensure that a crypto transaction in trade is subject to comparable risk safeguards regardless of the jurisdictions involved.

- **Stablecoins and Payment Tokens:** Given the specific importance of stablecoins for cross-border trade payments (they can reduce FX volatility and enable faster settlement), a harmonized approach to stablecoin regulation is vital. The reform proposal includes adopting international standards for stablecoin issuance (such as requirements for reserve assets, redemption rights, and prudential supervision). The Financial Stability Board (FSB) in 2020–2022 developed high-level recommendations for "global stablecoin" arrangements,[325] and CPMI-IOSCO in October 2021 applied principles for financial market infrastructure to systemically important stablecoins.[326] These should be integrated into domestic laws so that a stablecoin used in trade is safe and its legal status (as a claim on the issuer, etc.) is recognized across borders. Notably, a stablecoin that meets these standards could be treated analogously to electronic money or a bank deposit for regulatory purposes, which would facilitate its use in trade finance with legal predictability.

- **E-Commerce and Trade Facilitation Alignment:** The classification framework should dovetail with trade law developments. For example, electronic transferable records (like bills of lading on blockchain) are governed by the UNCITRAL

[323] See Int'l Org. of Sec. Comm'ns, *Policy Recommendations for Crypto and Digital Asset Markets* (2023), https://www.iosco.org/library/pubdocs/pdf/IOSCOPD742.pdf.
[324] See Basel Comm. on Banking Supervision, *Prudential Treatment of Cryptoasset Exposures*, at 2–5 (Dec. 2022), https://www.bis.org/bcbs/publ/d545.pdf.
[325] See Fin. Stability Bd., *High-Level Recommendations for the Regulation, Supervision and Oversight of Global Stablecoin Arrangements* (Oct. 2020), https://www.fsb.org/2020/10/high-level-recommendations/.
[326] See Comm. on Payments & Market Infrastructures & IOSCO, *Application of the Principles for Financial Market Infrastructures to Stablecoin Arrangements* (Oct. 2021), https://www.bis.org/cpmi/publ/d200.pdf.

Model Law on Electronic Transferable Records (MLETR) 2017.[327] If crypto tokens are used to represent trade documents or goods, their legal nature needs to mesh with instruments like MLETR and the recent UK Electronic Trade Documents Act 2023 (which legally equates certain digital records with paper documents for trade purposes)[328]. A holistic approach would ensure that tokenized trade assets are legally negotiable and transferable under uniform rules, boosting digital trade growth.

Implementation Pathways: Achieving global consensus on crypto regulation is admittedly challenging, but recent efforts indicate momentum. The G20 has taken up this issue: under India's 2023 presidency,[329] the G20 endorsed an IMF-FSB roadmap for crypto policy coordination that calls for implementation of comprehensive regulations and consistent standards across jurisdictions.[330] That endorsement can be leveraged to get commitments from major economies. The FSB's own recommendations (published in October 2023) provide a blueprint for minimum standards (e.g., "same activity, same risk, same regulation" principle, which urges that crypto activities should be subject to equivalent regulatory outcomes as traditional finance).[331] A combination of hard law and soft law could be used: for instance, a multilateral treaty or a model law on crypto-assets can be drafted (perhaps under UN auspices) which countries can adopt or adapt; concurrently, international standard-setters (FSB, FATF, IOSCO, Basel Committee) continue refining detailed guidance.[332] A periodic international forum – possibly within the WTO's remit if trade-related, or under the Bank for International Settlements (BIS) for financial stability – could monitor and coordinate the implementation, similar to how the Basel accords are implemented worldwide.

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[327] See United Nations Comm'n on Int'l Trade Law, *Model Law on Electronic Transferable Records* (2017), https://uncitral.un.org/en/texts/ecommerce/modellaw/electronic_transferable_records.
[328] See Electronic Trade Documents Act 2023, c. 28 (U.K.).
[329] G20, Leaders' Declaration: G20 New Delhi Summit 2023 ¶ 56 (Sept. 9–10, 2023), https://www.mea.gov.in/Images/CPV/G20-New-Delhi-Leaders-Declaration.pdf (last visited May 25, 2025).
[330] See Int'l Monetary Fund & Fin. Stability Bd., *IMF-FSB Synthesis Paper: Policies for Crypto-Assets*, at 2–3 (Sept. 2023), https://www.fsb.org/uploads/R070923-1.pdf (last visited May 18, 2025).
[331] Fin. Stability Bd., *Recommendations for the Regulation, Supervision and Oversight of Crypto-Asset Activities and Markets*, at 4–6 (Oct. 2023), https://www.fsb.org/2023/10/recommendations-for-the-regulation-supervision-and-oversight-of-crypto-asset-activities-and-markets/.
[332] See, e.g., FATF, *Updated Guidance for a Risk-Based Approach: VASPs* (2021); IOSCO, *Policy Recommendations for Crypto and Digital Asset Markets* (2023); Basel Comm. on Banking Supervision, *Prudential Treatment of Cryptoasset Exposures* (2022).

At a regional level, economic blocs could harmonize within themselves (the EU with MiCA is one example;[333] ASEAN or the African Union could develop regional frameworks drawing from global standards). These regional regimes can then be aligned with each other through mutual recognition or by all referencing the global standard.

In sum, by establishing a cohesive classification and regulatory treatment for crypto-assets, the international community would provide the legal clarity necessary for businesses to confidently use crypto in cross-border trade. It would mitigate the risk of law evasion and ensure that protections (against fraud, hacking, financial crime, etc.) travel with the assets across jurisdictions. Over time, as national laws converge on these model standards, the playing field becomes more level – encouraging compliance and innovation in the use of digital assets for trade and finance.

5.3.4 Evidentiary Standards for Blockchain Records and Smart Contracts

Proposal: Modernize and harmonize evidentiary rules so that blockchain records, digital signatures, and smart contract outputs are readily admissible and given appropriate weight in legal proceedings across jurisdictions. This could be achieved via a model law or uniform provisions (for example, a "Model Law on Digital Evidence") that jurisdictions adopt, or through amendments to existing evidence statutes. The core principle would be that records secured via blockchain (with proper cryptographic authentication) are presumed to be authentic and should be accepted as evidence of the transactions or facts they represent, barring specific rebuttal.[334] Additionally, procedures should be established for courts to handle technical aspects (like verifying a hash or understanding a smart contract's function) possibly through expert evidence or judicial notice of widely recognized blockchain processes.[335]

Rationale and Details: As blockchain technology permeates commercial transactions, disputes involving those transactions will increasingly turn on evidence that is natively digital – for instance, a time-stamped ledger of transfers, or the code of a smart contract itself. Traditional rules of evidence, which often evolved in a paper-based context, may

[333] Regulation 2023/1114 of the European Parliament and of the Council of 31 May 2023 on Markets in Crypto-Assets, 2023 O.J. (L 150) 40.
[334] See Vt. Stat. Ann. tit. 12, § 1913 (2018)
[335] See U.K. Law Comm'n, *Digital Assets: Final Report*, ¶¶ 6.45–6.57 (2023), https://www.skadden.com/-/media/files/publications/2024/09/uk-government-introduces-bill/digitalassetsreport.pdf (last visited May 27, 2025)

not explicitly accommodate such material. A lack of clear standards could result in inconsistent admissibility rulings, as discussed earlier. Harmonizing evidentiary treatment will improve cross-border dispute resolution by ensuring that if a blockchain record is admissible and probative in one country, it will likely be so in another, thus avoiding a scenario where the same digital evidence is deemed insufficient simply due to forum differences.

Important aspects of this reform include:

- **Authenticity Presumption:** Blockchain records should be treated as self-authenticating to a similar extent as certain electronic records or public documents. For example, Vermont's statute (Vt. Stat. Ann. tit. 12, § 1913) provides that a digital record on a blockchain, accompanied by a valid written certification by a qualified person, "shall be self-authenticating" and that facts verified through blockchain technology are authentic[336]. This kind of provision removes the need for extensive foundation testimony to prove that the record is what it purports to be, streamlining trials. The model law could incorporate such language, allowing any party to introduce a blockchain transaction log (e.g., printout or data file of relevant ledger entries) with a simple certification from a custodian or expert, and the court should accept it as prima facie evidence of the transaction's occurrence, timestamp, and contents.

- **Hearsay and Reliability:** A strict application of hearsay rules might otherwise bar out-of-court computer-generated records offered for their truth. Reforms can clarify that records generated by a regularly maintained blockchain can fall under existing exceptions (like business records or official records exceptions), or carve out a specific hearsay exception for blockchain records given their indicia of reliability (immutability, distributed verification). The unique trust attributes of blockchain – once properly explained – justify treating these records akin to automated instrument readings or other exceptions in evidence law for trustworthy technical outputs. For instance, one might compare a blockchain's consensus-validated record to the output of a securely maintained device, which some courts admit as non-hearsay or under a hearsay exception on the rationale that the potential for human error is minimized.

[336] Vt. Stat. Ann. tit. 12, § 1913 (2018).

Judicial Notice of Technical Aspects: Courts could be empowered (or guided) to take judicial notice of the general workings of well-known blockchain networks (like Bitcoin or Ethereum), much as they might do for the basic principles of email or GPS. This prevents each case from having to "re-prove" how blockchain works. In China's Internet Courts, for example, the judges are specialized and a judicial interpretation in 2018 explicitly recognized blockchain data as evidence if certain conditions are met, essentially instructing courts on how to treat such submissions[337]. A harmonized approach may involve training judges and publishing practice notes or rules that acknowledge blockchain technology's acceptance.

- **Expert Evidence and Technical Assistance:** The framework can also encourage the use of court-appointed experts or technical neutral parties to assist in interpreting smart contract evidence. If a dispute revolves around what a piece of code did, an expert might be needed to explain it in legal terms. Having a roster of accredited experts or using agreed technical statements can expedite proceedings. Procedural cooperation across borders (like via the Hague Evidence Convention) could be extended to obtaining blockchain evidence or expert testimony from abroad as needed.[338]

- **Mutual Recognition of Digital Evidence:** In cross-border litigation or arbitration, parties often face having to prove foreign law or the authenticity of foreign public documents. With blockchain, the concept of "foreign" evidence is blurry because the data is online and the same globally. Still, if one court has validated a piece of blockchain evidence, another court should be willing to accept that. One way is through international guidelines: for instance, the Chartered Institute of Arbitrators or UNCITRAL's arbitration rules could

[337] Supreme People's Court (China), Provisions on Several Issues Related to the Trial of Cases by the Internet Courts (Sept. 7, 2018) (trans. China Law Translate), https://www.chinalawtranslate.com/en/the-supreme-peoples-courts-provisions-on-several-issues-related-to-trial-of-cases-by-the-internet-courts/ (last visited April 29, 2025); Wolfie Zhao, *China's Supreme Court Recognizes Blockchain Evidence as Legally Binding*, Coindesk (Sept. 7, 2018; updated Sept. 13, 2018), https://www.coindesk.com/markets/2018/09/07/chinas-supreme-court-recognizes-blockchain-evidence-as-legally-binding/ (last visited May 21, 2025).

[338] Convention on the Taking of Evidence Abroad in Civil or Commercial Matters, Mar. 18, 1970, 847 U.N.T.S. 231, https://treaties.un.org/doc/Publication/UNTS/Volume%20847/volume-847-I-12140-English.pdf (last visited May 21, 2025).

incorporate guidance on treating blockchain data as evidence.[339] Another is through bilateral or multilateral agreements to recognize digitally signed records and time stamps (somewhat akin to the eIDAS Regulation in the EU, which ensures cross-member recognition of electronic signatures and timestamps).[340]

Implementing these evidentiary reforms will reduce the friction in enforcing smart contract and crypto-related rights. It complements the earlier proposals: for instance, even if a smart contract is recognized as valid (as per Proposal 5.3.1) and one knows which law applies (Proposal 5.3.2), one must still prove what happened on the blockchain in a court. Standardizing that proof process internationally ensures that outcomes do not diverge just because of procedural technicalities.

Implementation Pathways: A practical approach is via law reform commissions and uniform law conferences at the national or regional level, which often handle evidence law modernization. For example, the Uniform Law Commission in the U.S. could draft a uniform rule on blockchain evidence for states to adopt;[341] the Commonwealth Secretariat could update its Model Law on Evidence to include digital ledger provisions for commonwealth countries;[342] the EU could issue a directive or guidance on accepting DLT-based records in judicial proceedings. These efforts should be informed by experiences in jurisdictions that have already moved forward (such as the U.S. states Vermont and Ohio regarding blockchain records, China's judicial interpretations, and the UK's pilot programs using blockchain to secure evidence[343]). International bodies like UNCITRAL might integrate such rules into their texts – perhaps an annex to the

[339] See UNCITRAL, *UNCITRAL Arbitration Rules*, arts. 27–28 (2010), https://docs.pca-cpa.org/2016/01/UNCITRAL-2010-English.pdf (last visited May 21, 2025); Chartered Inst. of Arbitrators, *Tech & the Future of Dispute Resolution* (2020), https://www.ciarb.org/media/8974/ciarb-tech-and-future-of-dispute-resolution.pdf.

[340] Regulation 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market, 2014 O.J. (L 257) 73, https://eur-lex.europa.eu/eli/reg/2014/910/oj (last visited May 21, 2025).

[341] Uniform Law Comm'n, *Uniform Electronic Transactions Act* (1999), https://www.uaipit.com/uploads/legislacion/files/0000004550_UNIFORM%20ELECTRONIC%20TRANSACTIONS%20ACT.pdf (last visited May 21, 2025).

[342] Commonwealth Secretariat, *Model Law on Evidence*, Commonwealth Law Bulletin 43:1 (2017), https://thecommonwealth.org/commonwealth-model-laws (last visited May 21, 2025).

[343] Supreme People's Court (China), Provisions on Several Issues Related to the Trial of Cases by the Internet Courts (Sept. 7, 2018) (trans. China Law Translate), https://www.chinalawtranslate.com/en/the-supreme-peoples-courts-provisions-on-several-issues-related-to-trial-of-cases-by-the-internet-courts/ (last visited May 21, 2025); Wolfie Zhao, *China's Supreme Court Recognizes Blockchain Evidence as Legally Binding*, Coindesk (Sept. 7, 2018; updated Sept. 13, 2018), https://www.coindesk.com/markets/2018/09/07/chinas-supreme-court-recognizes-blockchain-evidence-as-legally-binding/ (last visited May 21, 2025).

Electronic Commerce instruments or a new project in the area of dispute resolution (UNCITRAL had previously done work on Online Dispute Resolution technical notes; it could extend to ODR involving blockchain evidence).[344]

Another avenue is within the framework of trade facilitation and commercial dispute resolution treaties. For instance, under the auspices of WTO or WIPO, member states could agree to evidentiary cooperation for digital trade, which includes recognition of electronic records. The Hague Conference could potentially explore a protocol on digital evidence to its Evidence Convention, ensuring that when one contracting state's court certifies a blockchain record, it is accepted in others.[345]

In all, by adopting harmonized evidentiary standards, we ensure that legal rights and obligations executed via blockchain do not falter at the stage of proof. Instead, courts and arbitral tribunals worldwide would have a consistent approach to evaluate and rely on the new forms of evidence that these technologies produce, thus bolstering the enforceability of smart contract-based arrangements in international trade.

5.4 Institutional Roles and Multilateral Frameworks

Realizing the above reform proposals requires coordination and support from key international institutions. No single nation can harmonize laws globally; thus, multilateral bodies with relevant mandates should take the lead in formulating and promoting the needed legal standards. This section examines the roles of four institutions in particular – UNCITRAL, FATF, WTO, and BIS (and related standard-setting bodies) – and how their efforts can converge to shape a coherent legal framework for blockchain and crypto in trade.

5.4.1 UNCITRAL (United Nations Commission on International Trade Law)

UNCITRAL, as the primary U.N. body for harmonizing international trade law, is

[344] United Nations Comm'n on Int'l Trade Law, *Technical Notes on Online Dispute Resolution* (2017), https://uncitral.un.org/sites/uncitral.un.org/files/media-documents/uncitral/en/v1700382_english_technical_notes_on_odr.pdf (last visited May 21, 2025).
[345] Hague Conf. on Priv. Int'l Law, *Convention on the Taking of Evidence Abroad in Civil or Commercial Matters*, Mar. 18, 1970, 847 U.N.T.S. 231.

uniquely positioned to develop legal standards for digital trade technologies.[346] Its mandate is to eliminate legal barriers to global trade by modernizing and unifying law, a mandate directly engaged by the challenges of blockchain commerce. UNCITRAL has a strong track record of producing influential model laws and conventions in areas of e-commerce (such as the Model Law on Electronic Commerce 1996[347], Model Law on Electronic Signatures 2001,[348] and the aforementioned Electronic Communications Convention 2005)[349]. Building on this, UNCITRAL's recent work explicitly addresses the digital economy: the Model Law on Automated Contracting (2024) is a testament to its ability to craft forward-looking frameworks.[350] Additionally, UNCITRAL has been exploring issues of digital identity, data transactions, and distributed ledger technology in its Working Groups – this indicates a recognition that blockchain-related legal issues are ripe for multilateral guidance.[351][352]

In the context of our proposals, UNCITRAL's potential contributions include:

- **Model Laws and Legislative Guides:** UNCITRAL can draft model legislative provisions for smart contract recognition (as it has now done with the MLAC 2024)[353] and for electronic transferable records (MLETR 2017, which many countries are now adopting to enable trade document digitization)[354]. A next step could be a Model Law or Guide on Digital Assets and Trade Transactions, synthesizing principles from instruments like MiCA, the UNIDROIT Digital

[346] See United Nations Comm'n on Int'l Trade Law, *About UNCITRAL*, https://uncitral.un.org/en/about, (last visited May 23, 2025).
[347] United Nations Comm'n on Int'l Trade Law, *Model Law on Electronic Commerce*, U.N. Doc. A/51/162 (1996), file:///C:/Users/acer/Downloads/19-04970_ebook%20(4).pdf (last visited May 23, 2025).
[348] United Nations Comm'n on Int'l Trade Law, *Model Law on Electronic Signatures*, U.N. Doc. A/56/17 (2001), https://uncitral.un.org/en/commission (last visited May 23, 2025).
[349] United Nations Convention on the Use of Electronic Communications in International Contracts, Apr. 6, 2005, 2898 U.N.T.S. 3, https://treaties.un.org/pages/ViewDetails.aspx?src=IND&mtdsg_no=X-18&chapter=10&clang=_en (last visited May 23, 2025).
[350] U.N. Comm'n on Int'l Trade Law, *Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited May 23, 2025).
[351] See United Nations Comm'n on Int'l Trade Law, *Working Group I: MSMEs and Legal Issues of Digital Identity*, https://uncitral.un.org/en/working_groups/1/msmes (last visited May 23, 2025).
[352] See also United Nations Comm'n on Int'l Trade Law, *Working Group IV: Electronic Commerce and DLT*, https://uncitral.un.org/en/working_groups/4/electronic_commerce (last visited May 23, 2025).
[353] U.N. Comm'n on Int'l Trade Law, *Model Law on Automated Contracting*, U.N. Doc. A/79/17, Annex IV (2024), https://uncitral.un.org/sites/uncitral.un.org/files/2424674e-mlautomatedcontracting-ebook.pdf (last visited May 23, 2025).
[354] United Nations Comm'n on Int'l Trade Law, *Model Law on Electronic Transferable Records* (2017), https://uncitral.un.org/en/texts/ecommerce/modellaw/electronic_transferable_records (last visited May 23, 2025).

Assets Principles,[355] and others into an international template. For example, UNCITRAL could collaborate with UNIDROIT to turn the latter's high-level principles into a model law that countries could enact, covering definitions, proprietary rights, and conflict of laws for digital assets used in commerce. By providing a well-drafted, internationally vetted text, UNCITRAL makes it easier for countries to implement harmonized rules, especially those with limited law reform resources.

- **Commentaries and Technical Assistance:** UNCITRAL also issues explanatory guides that help with uniform interpretation.[356] As countries adopt, say, the Model Law on Automated Contracting, UNCITRAL's secretariat can monitor and advise on consistency, ensuring the core tenets (like non-discrimination of smart contracts, attribution of actions of electronic agents, etc.) are implemented similarly worldwide. UNCITRAL often works closely with developing countries to build capacity – here it could train legislators and judges on how to handle blockchain contract cases under the new laws.[357]

- **Facilitating International Conventions:** If sufficient consensus builds, UNCITRAL might even spearhead a convention on certain aspects (for example, a narrow convention on the legal status of electronic transferable records has been discussed to complement the Model Law, or perhaps a future convention on the recognition of judicial decisions relating to digital assets if that becomes pressing).[358] Given that UNCITRAL operates by consensus of member states, its endorsement of legal principles lends them significant legitimacy.

By championing these issues, UNCITRAL helps ensure that reforms are not confined to advanced economies but extend globally, aligning with the needs of international trade

[355] UNIDROIT, *Principles on Digital Assets and Private Law* (2023), https://www.unidroit.org/wp-content/uploads/2024/01/Principles-on-Digital-Assets-and-Private-Law-linked-1.pdf (last visited May 23, 2025).
[356] United Nations Comm'n on Int'l Trade Law, *Guide to Enactment and Use of the UNCITRAL Model Law on Electronic Commerce* (1999), file:///C:/Users/acer/Downloads/19-04970_ebook%20(7).pdf (last visited May 23, 2025).
[357] United Nations Comm'n on Int'l Trade Law, *Technical Assistance and Coordination*, https://uncitral.un.org/en/content/technical-assistance-and-coordination (last visited May 26, 2025).
[358] United Nations Comm'n on Int'l Trade Law, *Future Work in Electronic Commerce: Proposal by the United States*, U.N. Doc. A/CN.9/1093 (2023), https://undocs.org/en/A/CN.9/1093. (last visited May 23, 2025).

participants across both developed and developing nations.

5.4.2 FATF (Financial Action Task Force)

The FATF, while not a trade law body, plays a critical role in the crypto-asset domain by setting globally recognized anti-money laundering and counter-terrorism financing (AML/CFT) standards. Since cryptocurrencies can be used to move value across borders outside traditional banking channels, FATF's mandate to mitigate illicit finance risk is directly engaged. In 2019, FATF amended its Recommendation 15 to cover "virtual assets" and "service providers of virtual asset," requiring member jurisdictions (which number over 200 through FATF and its regional bodies) to regulate such assets and entities for AML/CFT purposes.[359] FATF's 2021 updated guidance further fleshed out how countries should apply licensing, customer due diligence, suspicious transaction reporting, and the Travel Rule (requirement to share sender/receiver information on crypto transfers).[360]

In the context of harmonization:

- **Continued Monitoring and Pressure:** FATF serves as a driving force to push countries towards implementing laws that govern crypto transactions, which complements broader regulatory harmonization. By publicly reporting on countries' progress or lack thereof (as it did in its 2022 and 2023 reports showing many countries lagging on Travel Rule enforcement), FATF creates a form of peer pressure.[361] This encourages jurisdictions to enact the necessary legislation (often simultaneously clarifying the legal status of crypto businesses, which dovetails with the classification proposals). The FATF Roadmap adopted in February 2023 commits to accelerated implementation and capacity-building,

[359] Fin. Action Task Force, *International Standards on Combating Money Laundering and the Financing of Terrorism & Proliferation: The FATF Recommendations*, Recommendation 15, at 16–17 (updated June 2019), https://www.fatf-gafi.org/media/fatf/documents/recommendations/pdfs/FATF%20Recommendations%202012.pdf.
[360] Fin. Action Task Force, *Updated Guidance for a Risk-Based Approach to Virtual Assets and Virtual Asset Service Providers*, at 12–22 (Oct. 2021), https://www.fatf-gafi.org/media/fatf/documents/recommendations/Updated-Guidance-VA-VASP.pdf.
[361] Fin. Action Task Force, *Targeted Update on Implementation of the FATF Standards on Virtual Assets and VASPs*, at 2–4 (June 2023), https://www.fatf-gafi.org/publications/Virtual-assets/Targeted-Update-Implementation-June-2023.html.

especially in jurisdictions with significant virtual asset activity.[362] This focus will help close the AML gap identified in Section 5.2 by getting more countries to have at least baseline consistent rules.

- **Setting Norms that Influence Other Areas:** FATF standards, while focused on illicit finance, effectively dictate part of the regulatory framework for crypto globally. For example, any country implementing Recommendation 15 will by necessity define what a "virtual asset" and a "VASP" are. FATF's definitions (a digital representation of value that can be traded or transferred, etc.) have become de facto global definitions adopted in multiple national laws.[363] This harmonizes terminology and scope to an extent. Also, FATF's emphasis on not prohibiting innovation but rather mitigating risks has influenced the tone of national regulations – very few countries now impose total bans, as they aim to comply by regulating instead. Thus, FATF indirectly furthers the mainstreaming of crypto in commerce under a regulated paradigm.

- **Coordinating with Other Standard-Setters:** FATF works alongside bodies like the FSB, IMF, Basel Committee, etc., as evidenced by the joint reports to the G20.[364] The goal is to ensure AML considerations are embedded in the overall framework. For instance, as jurisdictions adopt MiCA-like regulations, FATF ensures alignment so that those regulations include robust AML provisions (e.g., requiring exchanges to implement the Travel Rule). In trade contexts, FATF can advise on typologies of trade-based money laundering involving crypto (for example, layering crypto payments through multiple jurisdictions to disguise proceeds) and how unified rules can combat that. FATF's collaborative efforts (through its Virtual Assets Contact Group and engagement with industry) also help identify emerging risks such as DeFi and unhosted wallets, which eventually need addressing in the legal frameworks.[365]

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[362] Fin. Action Task Force, *Roadmap for Strengthening Implementation of FATF Standards on Virtual Assets and VASPs*, at 1–2 (Feb. 2023), https://www.fatf-gafi.org/en/publications/Fatfgeneral/roadmap-virtual-assets.html.

[363] Fin. Action Task Force, *Glossary of FATF Terms: "Virtual Asset" and "VASP"*, https://www.fatf-gafi.org/glossary/.

[364] Fin. Stability Bd. & Fin. Action Task Force, *Joint Statement on Coordinated Work Regarding Crypto-Asset Activities* (July 2023), https://www.fsb.org/wp-content/uploads/FATF-FSB-IMF-statement-on-crypto.pdf.

[365] Fin. Action Task Force, *Second 12-Month Review of the Revised FATF Standards on Virtual Assets and VASPs*, at 14–18 (July 2021), https://www.fatf-

In summary, FATF's role is ensuring that any move toward liberalizing or normalizing crypto in trade (for its efficiency benefits) does not open the floodgates to illicit flows. By setting the floor of regulations globally, FATF helps create a safer environment in which the other proposals (like contract recognition and asset classification) can operate. A trade transaction using cryptocurrency will have a much higher chance of legitimacy if both the exporting and importing country have effective AML controls per FATF, thereby maintaining trust in the system. The continued priority should be on implementation – as FATF notes, a rule on paper is only as good as its enforcement. Thus, FATF will likely continue publishing updates and possibly conducting country evaluations specifically on crypto compliance. It is conceivable that in the future, non-compliance (like not having Travel Rule laws) could factor into FATF's mutual evaluations, which can influence a country's financial reputation.

5.4.3 WTO (World Trade Organization)

The WTO an arbiter of international trade regulations, has a more indirect but potentially significant role in the context of blockchain and cryptocurrency. While the WTO agreements (dating from the 1990s for the most part) do not explicitly address cryptocurrencies or distributed ledger technology, their broad provisions on trade in goods, services, and intellectual property can be implicated.[366] Moreover, the WTO provides a forum where new rules for digital trade might emerge, either through multilateral agreement or plurilateral initiatives.

Relevant considerations for the WTO include:

- **Trade in Services (GATS) and Financial Services Commitments:** Cryptocurrency-related services (such as crypto exchanges, payment providers, and blockchain network services) could be classified under financial services or software-related services in the WTO's General Agreement on Trade in Services (GATS).[367] If a WTO member has made commitments in certain financial

gafi.org/media/fatf/documents/recommendations/Second-12-Month-Review-Revised-FATF-Standards-Virtual-Assets-VASPs.pdf.

[366] See Marrakesh Agreement Establishing the World Trade Organization, Apr. 15, 1994, 1867 U.N.T.S. 154;
See also World Trade Org., *Joint Statement on Electronic Commerce*, WT/L/1056 (Jan. 25, 2019), https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/WT/L/1056.pdf (last visited April 26, 2025).

[367] See General Agreement on Trade in Services, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1B, 1869 U.N.T.S. 183.

services modes, an outright ban on crypto trading platforms might be challenged as a breach of market access or national treatment obligations. For instance, there was speculation that China's prohibitions on cryptocurrency trading (for domestic and cross-border transactions) could conflict with its WTO commitments for financial services, potentially opening a dispute. To date, no formal dispute ruling has clarified this. However, the possibility means the WTO has a stake in how countries regulate crypto – a patchwork of restrictive measures could be viewed as trade barriers. In the future, as more countries regulate rather than ban, ensuring those regulations are non-discriminatory and proportional could become a WTO issue (analogous to how regulations in other sectors are subject to trade law disciplines).

- **Customs and E-Commerce:** The WTO moratorium on customs duties on electronic transmissions (renewed in subsequent Ministerials) hints at a philosophy of keeping digital goods/services flows open.[368] Cryptocurrency might be seen as a form of electronic transmission of value. If countries attempted to impose tariffs or restrictions on cross-border crypto payments (for example, treating them like foreign currency transfers), it could raise questions under the WTO framework. Additionally, blockchain is being leveraged to facilitate trade logistics and compliance (e.g., in customs documentation, origin tracing for goods). The WTO has recognized the potential of blockchain to reduce trade costs and enhance transparency.[369] Through its Trade Facilitation Committee or other working groups, the WTO can encourage members to accept electronic documentation (something already in the Trade Facilitation Agreement) and arguably, by extension, to recognize blockchain-based documents and certify their legality (tying back to instruments like UNCITRAL's MLETR).

- **Joint Statement Initiative on E-Commerce:** Currently, a group of over 80 WTO members are negotiating a plurilateral agreement on electronic

[368] See World Trade Org., *Moratorium on Customs Duties on Electronic Transmissions*, WT/MIN(21)/37 (Dec. 17, 2021), https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/WT/MIN21/37.pdf.
[369] See World Trade Org., *Can Blockchain Revolutionize International Trade?*, WTO Staff Working Paper ERSD-2018-10 (Nov. 27, 2018), https://www.wto.org/english/res_e/booksp_e/blockchainrev18_e.pdf (last visited May 22, 2025).

commerce.[370] Issues on the table reportedly include electronic signatures, authentication, data flows, and potentially source code non-discrimination. Although cryptocurrency is not explicitly front and center, any outcome that facilitates digital trade (for example, requiring members to have laws recognizing e-signatures and electronic contracts, or to not impose data localization that could hamper blockchain networks) will indirectly support the legal infrastructure for blockchain trade. Some countries might push to include provisions ensuring that measures on digital currencies are not trade-restrictive beyond what's necessary for regulatory objectives – a parallel to commitments on e-payment services. The Mercatus Center has even suggested the WTO consider a model law approach for digital trade given the erosion of territorial notions, indicating academic interest in having the WTO take a more active role.[371]

- **Dispute Resolution and Coordination:** The WTO's dispute resolution mechanism could be a backstop for egregious barriers. For example, if one country confiscates crypto-assets of foreign traders or prohibits exchanges from serving foreign customers arbitrarily, affected countries could have recourse via WTO if trade commitments are violated. Even without formal disputes, the WTO's committees (like the Financial Services Committee) provide a venue to discuss and peer-review national measures. Greater transparency of crypto regulations can be achieved by using the WTO's notification processes (members notify new measures affecting trade). For instance, if a country introduces licensing for crypto exchanges, notifying it could invite comments or concerns from trading partners. In essence, the WTO can contribute by ensuring that domestic regulatory measures in this sphere align with trade principles: transparency, non-discrimination, and avoidance of unnecessary barriers. It can also promote capacity building – working with organizations like the World Bank and IMF to help developing countries regulate crypto in a way that still allows them to reap digital trade benefits. Finally, WTO research and policy dialogues (the WTO has published studies on blockchain's impact on trade

[370] See World Trade Org., *Joint Statement on Electronic Commerce*, WT/L/1056 (Jan. 25, 2019), https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/WT/L/1056.pdf. (last visited May 22, 2025).
[371] See Daniel J. Ikenson & Inu Manak, *A WTO Model Law for Digital Trade*, Mercatus Center Policy Brief (2020), https://www.mercatus.org/research/policy-briefs/wto-model-law-digital-trade.

finance and supply chains) can disseminate best practices and encourage international cooperation, complementing the legal harmonization work of other bodies.[372]

5.4.4 BIS and Other Financial Standard-Setters (FSB, Basel Committee, IOSCO)

The Bank for International Settlements (BIS) and its associated committees serve as a central coordinating hub for central banks and financial regulators in setting standards that often become transnational norms. The BIS's involvement in crypto-asset policy has grown significantly, primarily through:

- **The Financial Stability Board (FSB):** While technically separate (the FSB reports to G20 finance ministers and central bank governors), it is hosted by the BIS and includes major regulators. The FSB's comprehensive framework for crypto-asset regulation, delivered in 2023, provides high-level recommendations focusing on safeguarding financial stability – such as requiring same regulatory outcomes for crypto as equivalent traditional activities, addressing risks of stablecoins, and enhancing global cooperation in supervision.[373] G20 endorsement of these FSB recommendations gives them political weight.[374] As FSB members implement these, we will see more uniform regulatory approaches. For example, one FSB recommendation is that authorities should have powers to prohibit or restrict the activities of crypto assets that excessively risk financial stability, which could lead to convergence in how countries handle, say, algorithmic stablecoins or highly leveraged crypto products.

- **Basel Committee on Banking Supervision:** In December 2022, the Basel Committee (under BIS) issued final rules on the prudential treatment of banks'

[372] See World Trade Org., *Can Blockchain Revolutionize International Trade?*, WTO Staff Working Paper ERSD-2018-10 (Nov. 27, 2018), https://www.wto.org/english/res_e/booksp_e/blockchainrev18_e.pdf (last visited May 25, 2025).
[373] See Fin. Stability Bd., *Recommendations for the Regulation, Supervision and Oversight of Crypto-Asset Activities and Markets* (Oct. 2023), https://www.fsb.org/2023/10/recommendations-for-the-regulation-supervision-and-oversight-of-crypto-asset-activities-and-markets/ (last visited May 23, 2025).
[374] See also G20, Leaders' Declaration: G20 New Delhi Summit 2023 ¶ 57 (Sept. 2023), https://www.mea.gov.in/Images/CPV/G20-New-Delhi-Leaders-Declaration.pdf (last visited May 25, 2025).

crypto-asset exposures.[375] These rules, which will be implemented by 2025, classify crypto-assets into groups and set conservative capital requirements, especially for unbacked crypto (like Bitcoin) and unstable stablecoins, while allowing lower capital for tokenized traditional assets and well-regulated stablecoins. This directly affects banks globally – any bank under Basel standards will have to adhere. Indirectly, it also influences the trade ecosystem: banks are key in trade finance, and if they hold or accept crypto assets (whether as collateral or for payment), there is now a clear, harmonized regulatory expectation. The Basel standards ensure that banks approach crypto with caution and adequate buffers, thereby mitigating risk of a cross-border financial contagion event stemming from crypto volatility. By coordinating this internationally, the Basel Committee prevents regulatory arbitrage (banks shopping for jurisdictions with no crypto capital rules). A harmonized bank regulatory stance also reassures central banks, making them less likely to push for outright bans and more likely to integrate crypto into existing systems under supervision.

- **IOSCO (International Organization of Securities Commissions):** IOSCO has been active in examining how securities regulation principles apply to crypto markets. In 2022, its Fintech Task Force outlined key considerations for regulating crypto trading platforms and ICOs, emphasizing disclosure, fraud prevention, and conflicts of interest management. In May 2023, IOSCO released a detailed consultation report with recommendations for crypto and digital asset markets, covering issues like custody, operational risks, market manipulation, and retail protection.[376] Once finalized, those IOSCO recommendations will guide national securities regulators to align their crypto oversight. For cross-border trading of crypto assets that may be securities or investment products, this means more uniform listing rules, surveillance, and enforcement standards, which collectively protect market integrity across jurisdictions. If every major market follows IOSCO's lead to, say, require crypto exchanges to separate client assets (a basic protection to prevent another FTX-like collapse),

[375] See Basel Comm. on Banking Supervision, *Prudential Treatment of Cryptoasset Exposures: Final Standard* (Dec. 2022), https://www.bis.org/bcbs/publ/d534.pdf.
[376] See Int'l Org. of Sec. Comm'ns, *Policy Recommendations for Crypto and Digital Asset Markets: Consultation Report* (May 2023), https://www.iosco.org/library/pubdocs/pdf/IOSCOPD734.pdf.

international investors and traders gain confidence and the chance of a regulatory race to the bottom diminishes.

- **BIS Innovation Hub and Committees:** The BIS itself has an Innovation Hub exploring uses of blockchain (including central bank digital currencies (CBDCs) and tokenized securities in cross-border payments). The Committee on Payments and Market Infrastructures (CPMI) at BIS has examined how payment systems and clearing might incorporate DLT, and importantly how to set standards for interoperability and security. One example is the joint CPMI-IOSCO work on applying Principles for Financial Market Infrastructures (PFMI) to stablecoin arrangements, essentially saying a stablecoin that is systemic must observe the same principles as a payment system or clearinghouse.[377] By enforcing such standards, BIS-related bodies ensure that any crypto-related infrastructure that becomes integral to international trade (like a stablecoin network for global remittances or a blockchain-based trade finance platform) meets baseline safety and efficiency criteria.

In sum, the BIS and its affiliated standard-setters provide the financial rule framework that complements legal rule harmonization. They tackle aspects like risk management, capital adequacy, market integrity, and investor protection in a coordinated way. Their role is indispensable because even if contract law is harmonized, if financial regulators wildly diverge, companies would still face an uneven environment. Through the BIS, central banks also coordinate on issues like monetary sovereignty and capital flow effects of crypto (the IMF-FSB paper noted risk of crypto-ization in emerging markets).[378] BIS in its economic reports often calls crypto's flaws out and suggests regulatory containment or integration strategies. The institutional skepticism from BIS quarters actually helps in crafting balanced policy – neither an uncritical embrace (which could lead to instability) nor blanket rejection (which might stifle beneficial innovation). Their collective stance influences national regulators who participate in these bodies.

[377] See Comm. on Payments & Mkt. Infrastructures & Int'l Org. of Sec. Comm'ns, *Application of the Principles for Financial Market Infrastructures to Stablecoin Arrangements* (July 2022), https://www.bis.org/cpmi/publ/d202.pdf.
[378] See Int'l Monetary Fund & Fin. Stability Bd., *IMF-FSB Synthesis Paper: Policies for Crypto-Assets*, at 6–7 (Sept. 2023), https://www.fsb.org/uploads/R070923-1.pdf (last visited May 23, 2025).

Going forward, continued cooperation between these institutions is key. We already see that happening (FSB and IMF jointly reporting, BIS committees working with IOSCO, FATF with FSB, etc.). Perhaps a formal joint forum on crypto regulation could be established under the G20 or FSB, to ensure ongoing alignment as the technology evolves (similar to how climate-related financial risks are tackled by multiple bodies but coordinated through forums). With these institutions fulfilling their roles, the policy proposals in Section 5.3 gain the needed support structure to be implemented effectively around the world.

5.5 Recommendations for India and the Global South

While global policy harmonization benefits all, it is particularly critical to tailor recommendations for India and other Global South countries. These jurisdictions often have fast-growing crypto adoption rates (for example, India, Vietnam, Nigeria, and Brazil rank among the highest in cryptocurrency usage), driven by factors like remittances, financial inclusion needs, and volatile local currencies.[379] Yet, they also face capacity constraints, unique economic risks, and sometimes external regulatory pressures. The following recommendations aim to ensure that India and its peers in the developing world not only adopt the international best practices outlined above but do so in a way that advances their own economic interests and development goals:

- **Active Participation in Rule-Making:** India and Global South regulators should continue to actively engage in international discussions on crypto and fintech regulation (through G20, BIS, IOSCO, UNCITRAL, etc.), to make sure their perspectives shape the emerging global framework. As seen in 2023, India's presidency of the G20 put crypto regulation on the agenda and facilitated global talks.[380] This proactive approach should persist: for example, India could lead in proposing model laws at UNCITRAL that account for developing country contexts, or champion pilot projects for cross-border payments using regulated crypto (like the BIS-led Project Nexus or mBridge for CBDCs, which involve emerging economies). Global South countries need to avoid simply

[379] See Chainalysis, *The 2023 Geography of Cryptocurrency Report: Global Crypto Adoption Index* (Sept. 2023), https://www.chainalysis.com/blog/2023-global-crypto-adoption-index/ (last visited May 23, 2025).
[380] See G20, Leaders' Declaration: G20 New Delhi Summit 2023 ¶¶ 57–58 (Sept. 9–10, 2023), https://www.mea.gov.in/Images/CPV/G20-New-Delhi-Leaders-Declaration.pdf (last visited May 23, 2025).

being "rule-takers." By contributing to standard-setting, they can ensure the resulting regulations consider issues like capital flow volatility, financial inclusion, and technology transfer.

- **Calibrated Legal Reforms Domestically:** On the home front, India and similar countries should move from a stance of uncertainty to one of clarity. In India, as of 2025, there is not yet a comprehensive crypto legislation; however, signals suggest the government seeks a global consensus before domestic law.[381] With global principles now coalescing, India can draft a law that, for example, defines crypto-assets, distinguishes their types (without making any one of them legal tender, in line with IMF advice), and sets up a licensing regime for crypto service providers consistent with FATF standards. At the same time, contract and commercial law should be updated – perhaps by adopting the UNCITRAL Model Law on Automated Contracting – to recognize smart contracts in the Indian legal system. India's IT Act and Evidence Act might be amended to explicitly cover blockchain records and digital signatures, drawing on other countries' experiences. Such reforms would give businesses confidence that using blockchain will not put them in a legal gray zone. For Global South nations with nascent legal systems, technical assistance (possibly through UNCITRAL or Commonwealth Secretariat) can help draft these laws efficiently. The aim is policy coherence: align with global norms to facilitate cross-border acceptance (so an Indian crypto exchange's license might be recognizable elsewhere in future frameworks), while tailoring to local needs (like ensuring the law empowers the central bank to address currency risks or scam protections for retail consumers given lower financial literacy).

- **Financial Inclusion and Innovation Sandboxes:** Embracing harmonized laws should not mean stifling innovation. India and its peers should complement strict regulations with regulatory sandboxes and innovation hubs that allow experimentation under oversight. For instance, India's securities and banking regulators already have sandbox programs for blockchain-based innovations in trade finance and KYC.[382] Expanding these will help domestic companies

[381] *Id.*
[382] See Reserve Bank of India, *Enabling Framework for Regulatory Sandbox* (Aug. 13, 2019), https://www.rbi.org.in/Scripts/PublicationReportDetails.aspx?UrlPage=&ID=938 (last visited May 23,

become competitive in developing solutions that comply with the new laws. It's also recommended to explore public-private partnerships for using blockchain in areas beneficial for development: land registries, identity management, supply chain transparency for agriculture, etc. A clear legal framework as proposed provides the certainty to invest in these areas. Moreover, by focusing on how these technologies can solve local problems (such as reducing remittance costs – a World Bank priority – or improving access to trade finance for small exporters), Global South countries ensure that the harmonization is not merely a checkbox exercise but tangibly benefits their economies. This approach turns a potential brain drain (talent leaving for jurisdictions with clear laws) into a brain gain (talent staying to build compliant, innovative services at home).

- **Protecting Sovereign Interests:** One understandable concern for emerging economies is that cryptocurrencies might undermine monetary sovereignty or facilitate capital flight. The harmonized approach advocated (with strong AML controls, licensing, and possibly restrictions on certain high-risk activities) can mitigate a lot of this, but countries can go further if needed in a calibrated way. For example, while outright bans are discouraged (they tend to drive activity underground and miss out on innovation), measures like transaction limits, taxation, and requiring domestic trading through regulated entities can be employed. India, for instance, introduced a tax on crypto transactions in 2022 and strict reporting, which tempered speculative trading.[383] As global standards solidify, India could refine such measures – possibly reducing penal tax rates once robust investor protection and tax reporting systems are in place, to strike a balance between curbing excess and not crippling the industry. Similarly, other developing countries might restrict stablecoins that are seen as threatening local currency, unless those stablecoins are properly backed and regulated (following something like the FSB's stablecoin recommendations). The key is that any such measures should ideally be coordinated regionally or internationally to avoid inconsistent approaches. The IMF's advice that crypto should not be granted

2025);
See also Sec. & Exch. Bd. of India, *Framework for Innovation Sandbox*, SEBI/HO/ITD/ITD/CIR/P/2019/76 (Dec. 30, 2019), https://www.sebi.gov.in/legal/circulars/dec-2019/framework-for-innovation-sandbox_45424.html.

[383] See Ministry of Finance (India), *Union Budget 2022–23: Taxation of Virtual Digital Assets*, https://www.indiabudget.gov.in/doc/bspeech/bs202223.pdf (see ¶131 of the Budget Speech).

official currency or legal tender status is heeded by most (El Salvador and Central African Republic being exceptions, and they faced IMF criticism).[384] Global South nations, largely IMF members, will likely follow that guidance to maintain stability, which itself is a form of harmonization on a critical point.

- **Leveraging Multilateral Development Support:** Implementing new regulatory frameworks can strain resources. Therefore, India and others should leverage support from multilateral development banks and forums. For example, the World Bank and IMF can provide technical assistance for setting up supervisory tech ("suptech") to oversee crypto transactions and enforce AML (some IMF capacity development work is already targeting this need).[385] The Asian Development Bank or African Development Bank might fund digital infrastructure projects that use blockchain for trade single-windows or port logistics, ensuring those projects align with legal standards like MLETR for digital trade documents. By being recipients and active participants in such projects, Global South countries gain both the infrastructure and the know-how to be equals in the new digital trade order.

- **South-South Cooperation:** Finally, collaboration among the Global South could amplify their voice and share best practices. Regional organizations (ASEAN, African Union, Mercosur, SAARC, etc.) could establish working groups on fintech law. They might adopt regional guidelines that mirror global ones but with regional priorities (for instance, addressing currency substitution concerns in dollarized economies, or using crypto to boost intra-regional trade where correspondent banking is weak). India could take a leadership role in forums like the BRICS or Commonwealth to drive a common approach – indeed, India has reportedly worked with other BRICS countries on discussing a shared crypto framework in the past.[386] The advantage is that a united Global South stance can ensure that when global rules (set by G7-dominated bodies) are

[384] See Int'l Monetary Fund, *Elements of Effective Policies for Crypto Assets*, IMF Policy Paper No. 2023/009, at 10–11 (Feb. 2023), https://www.imf.org/en/Publications/Policy-Papers/Issues/2023/02/23/Elements-of-Effective-Policies-for-Crypto-Assets-530092.
[385] See Int'l Monetary Fund, *Elements of Effective Policies for Crypto Assets*, IMF Policy Paper No. 2023/009, at 14–15 (Feb. 2023), https://www.imf.org/en/Publications/Policy-Papers/Issues/2023/02/23/Elements-of-Effective-Policies-for-Crypto-Assets-530092.
[386] See Ministry of Finance (India), *Press Release: BRICS Finance Ministers and Central Bank Governors Meeting* (Oct. 2022), https://pib.gov.in/PressReleasePage.aspx?PRID=1869227.

implemented, they come with flexibility and support appropriate to emerging markets, rather than a one-size-fits-all model that might be too burdensome or misaligned with local contexts.

In conclusion, the message for India and the Global South is to engage, adapt, and adopt: engage internationally to shape rules, adapt those rules to domestic context, and adopt them to reap the benefits of innovation while managing risks. By doing so, these countries can transform from being arenas of regulatory uncertainty into champions of a balanced legal framework that unlocks blockchain's potential for development – whether that be cheaper remittances, more accessible trade finance, or greater transparency in governance.

5.6 Conclusion

Chapter 5 has set forth a comprehensive set of policy reform proposals aimed at harmonizing the laws governing smart contracts and crypto-assets in international trade. We began by identifying the pressing gaps – fragmented regulations, uncertain contract enforceability, conflict-of-law quandaries, uneven compliance enforcement, evidentiary hurdles, and the lack of tailored dispute mechanisms – that currently impede the effective and secure use of blockchain technology in cross-border commerce. Building on the doctrinal findings of Chapter 3 and the comparative survey in Chapter 4, the chapter proposed concrete solutions anchored in emerging international consensus and best practices.

At the heart of these proposals is the pursuit of legal clarity and predictability across jurisdictions. Harmonizing smart contract recognition ensures that code-based agreements are universally seen as valid contracts, allowing businesses to rely on automation without fear of legal voids. Enhancing cross-border enforceability through conflict-of-law rules and jurisdictional cooperation addresses the very modern challenge of decentralized transactions straddling multiple legal systems, thereby giving parties confidence that their rights can be adjudicated and enforced wherever necessary. A unified approach to crypto-asset classification and regulation tackles the patchwork of definitions and rules that have thus far created arbitrage and confusion; it promises a world where a token or digital coin will be treated similarly by the law of each trade partner, reducing regulatory friction and increasing safety. Upgrading evidentiary

standards for the digital age ensures that the factual underpinnings of blockchain-based deals – the records and data – are readily usable in courts and arbitral tribunals globally, converting the blockchain's inherent transparency into legal truth.

The roles of institutions like UNCITRAL, FATF, WTO, and BIS were examined to illustrate that law reform is a collaborative international enterprise. Each institution provides pieces of the puzzle: UNCITRAL with legal texts that unify commercial law, FATF with enforcement-focused rules that guard the system's integrity, WTO with a platform to align these new rules with trade obligations and keep markets open, and BIS (with standard-setters) with the financial regulatory guardrails to maintain stability and trust. Together, they form an ecosystem in which the proposed reforms can thrive. It is clear that no single country (especially not emerging economies) can achieve the needed alignment on its own; but with these bodies facilitating consensus, even smaller nations can adopt robust frameworks with confidence that they mesh with global norms.

For India and its Global South peers, the chapter emphasized the importance of not remaining on the sidelines. These nations stand to gain immensely from blockchain and cryptocurrencies – whether through financial inclusion, easier access to global markets for SMEs, or more resilient remittance channels – but only if the legal infrastructure keeps pace. The recommendations urge them to be proactive rule-makers and prudent rule-takers, blending international standards with local innovations. India's stance at the G20 and similar forums shows the impact that a single country's initiative can have on galvanizing global policy; by continuing in that direction and implementing the reforms at home, India could emerge as a model in the digital economy for striking a balance between innovation and regulation, guiding other developing nations.

In closing, the harmonization proposals in this chapter aim to strike an equitable balance: fostering a legal environment that enables technological advancements to flourish in international trade, while safeguarding fundamental legal values of certainty, fairness, and security. As this dissertation moves to its conclusion in the next chapter, the focus will turn to synthesizing how these proposed legal reforms – if realized – can address the challenges identified at the outset of our study. We will consider the road ahead: the opportunities that a harmonized framework unlocks for global trade, the remaining obstacles to implementation, and the dynamic relationship between law and technology in the blockchain era. The analysis throughout has underscored that while

technology may transcend borders and traditional legal notions, the rule of law remains crucial in channeling that technology for the common good. Chapter 5's proposals, therefore, serve as a blueprint for that legal evolution – one that promises to transform the legal challenges of blockchain in trade into opportunities for more inclusive, efficient, and trustworthy international commerce.

CHAPTER 6

CONCLUSION, LEGAL REFORM AND FUTURE DIRECTIONS

6.1 Synthesis of Chapters 2–5

Chapters 2–5 demonstrated that blockchain and cryptocurrency innovations offer both theoretical promise and practical advances for international trade. Chapter 2 developed the technological foundations: blockchain's immutable distributed ledger and *smart contracts* can automate trade terms (e.g. payments and title transfers) without central intermediaries, theoretically reducing fraud and delays.[387] Chapter 3 analyzed how these technical features could transform trade finance and logistics: immutable transaction records improve supply-chain transparency, and end-to-end digital documentation can cut transaction times from months to days.[388] Empirically, blockchain pilots in commodities trade show reduced double-financing and greater real-time visibility.[389]

Chapters 4–5 examined the legal challenges of applying blockchain in trade. Key findings were that existing law often lacks clarity on blockchain specifics: for example, distributed ledger entries defy easy categorization under traditional property or contract rules, raising *private international law* issues.[390] The "code-is-law" debate also emerged: while on-chain code can enforce actions automatically, courts and legislators (following Lessig's insight) generally hold that code must operate within the framework of existing law.[391] This means that smart contracts in trade will only be binding when they meet traditional contract elements (offer, acceptance, consideration) and statutory formalities.[392] We also found regulatory gaps: for instance, no uniform rule exists on whether and how cryptocurrencies count as currency or assets in trade, or how digital

[387] Deloitte, Blockchain: A Technical Primer (2020), https://www2.deloitte.com/content/dam/insights/us/articles/4436_Blockchain-primer/DI_Blockchain_Primer.pdf (last visited May 22, 2025).
[388] *Id*
[389] Consensys, Blockchain and Trade Finance: A Primer (2021), https://consensys.io/blog/enterprise-blockchain/blockchain-in-trade-finance.
[390] Jan Smits, Blockchain, Private International Law and the Concept of a Legal Order, Conflict of Laws .net (2023), https://conflictoflaws.net/2023/blockchain-and-conflict-of-laws.
[391] Quinn Emanuel Urquhart & Sullivan, LLP, Smart Contracts and the Law: A Global Perspective (2022), https://www.quinnemanuel.com/the-firm/news-events/article-june-2022-smart-contracts-and-the-law.
[392] Sideman & Bancroft LLP, How Courts Are Treating Smart Contracts (2023), https://www.sideman.com/smart-contracts-revisited-lessons-from-the-courts-in-2025/ (last visited May 22, 2025).

signatures interact with bills of lading. In short, the dissertation showed that while blockchain's trust, transparency and automation can enhance global trade (e.g. by digitizing letters of credit and tracking provenance), significant doctrinal and regulatory work remains to integrate these tools into the legal system.

6.2 International Legal Reform Opportunities

Despite these challenges, many jurisdictions are moving to adapt. - **European Union:** The EU is forging a comprehensive framework. In 2023 the EU adopted the Markets in Crypto-Assets Regulation (MiCA), which institutes uniform rules for issuers and traders of crypto-assets (including stablecoins) with an aim to protect consumers and market stability.[393] Simultaneously, the Commission's *Blockchain Observatory* launched a pan-European regulatory *sandbox* for DLT projects, providing a safe space for innovators to test use-cases (such as trade finance platforms) under regulator guidance. These measures reflect the EU's dual approach of giving legal certainty (via clear rules and pilot regimes) while promoting innovation.

- **India:** India is rapidly updating its trade laws for blockchain. In March 2025 Parliament passed a landmark amendment to the Indian Bills of Lading Act 1856, clarifying that all contractual rights and title under a bill of lading pass with the document and that a transferred bill of lading in the hands of a bona fide holder is "conclusive evidence" of cargo on board.[394] This reform explicitly embraces *electronic transferable records* (ETRs) by bringing bills of lading into the digital era. India is also piloting electronic bills of lading (e-BLs) within its Electronic Port Community System (e-PCS), and has begun cross-border e-BL exchange (e.g. with South Korea) to speed customs clearance. Most recently, industry commentators note that India is considering adopting the UNCITRAL Model Law on Electronic Transferable Records (MLETR): Singapore's Electronic Transactions (Amendment) Act 2021 (based on MLETR) now recognizes e-BLs, and India aims to enact similar provisions to ensure its e-BLs

[393] Council of the European Union, Markets in Crypto-Assets (MiCA): Council Adopts New Rules (May 2023), https://www.consilium.europa.eu/en/press/press-releases/2023/05/16/digital-finance-council-adopts-new-rules-on-markets-in-crypto-assets-mica/pdf/ (last visited May 22, 2025).
[394] Finextra, India Moves Towards Paperless Trade with E-Bill Reforms (2025), https://www.finextra.com/newsarticle/42590/india-moves-towards-paperless-trade.

are legally valid.[395] These steps – aligning domestic law with international model laws – promise to reduce legal friction in trade documentation.

- **Asia-Pacific:** Across Asia-Pacific, economies are harmonizing their digital trade rules. For example, APEC's latest report (February 2025) highlights that inconsistent e-document laws among member economies are a major barrier to paperless trade, and it urges all members to adopt a legal framework based on MLETR to enable e-transfers of bills, invoices and warehouse receipts. Countries like Singapore, Japan, Australia and others have already enacted or are drafting MLETR-based laws.[396] ASEAN and APEC initiatives similarly promote model laws: under APEC's *Path to Paperless Trade* analysis, aligning national laws with MLETR could yield multibillion-dollar gains in ease of trade. Singapore's bilateral Digital Economy Partnership Agreements (e.g. with Chile and New Zealand) and frameworks (DEPA, UK–Singapore DEA) include provisions for electronic documents and data interoperability. These regional efforts aim to make the Asia-Pacific a leader in cross-border blockchain-enabled trade.

- **Global South:** Developing regions are also moving forward. In Africa, the African Union has prioritized a *digital trade protocol* under the AfCFTA (African Continental Free Trade Area).[397] Recent analyses note that MLETR should serve as the model for this protocol, enabling e-transferable records across African borders. The AfCFTA Phase III digital protocol is explicitly expected to address electronic bills of lading and other trade documents, which would significantly boost intra-African trade efficiency. Similarly, Latin American trade groups and Mercosur have begun discussions on digital documentation standards (e.g. blockchain for certificates of origin), and pilot projects (like Cadena in Latin America) are automating authorized economic operator (AEO) data-sharing under a regional blockchain platform. In summary, while resource gaps remain, trade law in the Global South is evolving through

[395] Timber Exchange, India–South Korea Blockchain Bill of Lading Pilot (2024), https://www.timber.exchange/blogs/india-south-korea-blockchain-pilot.
[396] Asia-Pacific Economic Cooperation (APEC), 2025 Digital Trade Readiness Report, https://www.apec.org/publications/2025/02/digital-trade-readiness-report.
[397] Afro-Nomics Law, AfCFTA Digital Protocols and Blockchain (2025), https://www.afronomicslaw.org/category/afcfta-digital-trade.

regional agreements and UNCITRAL model law adoption, offering fertile ground for harmonized digital trade regulations.

6.3 Balancing Regulatory Certainty and Innovation

A central tension identified by Chapters 2–5 (and confirmed in practice) is between legal certainty and technological innovation. On one hand, market participants demand clear rules: without regulatory certainty, firms hesitate to invest in blockchain solutions. For example, U.S. lawmakers in 2025 reintroduced the *Blockchain Regulatory Certainty Act* to provide a federal "safe harbor" for developers by clarifying that merely writing or maintaining blockchain code (absent handling customer funds) does not make them money transmitters or financial institutions.[398] Likewise, the EU's blockchain sandbox explicitly aims to *increase legal certainty* for innovators by pairing projects with regulators for guidance.[399] On the other hand, policymakers caution that over-regulation could stifle crypto and blockchain innovation. Industry experts and policy analysts warn that burdensome laws or hostile regulation push entrepreneurs and R&D offshore, hindering the very opportunities blockchain promises.[400]

The optimal approach seems to lie in targeted clarity: provide baseline consumer protections (e.g. anti-fraud rules, anti-money-laundering standards) and legal recognition of digital forms, while leaving room for new business models. The EU's MiCA, for instance, sets out transparency, disclosure and prudential standards for crypto-asset issuers but explicitly fosters innovation by adopting technology-neutral definitions.[401] Similarly, regulatory sandboxes (EU) or safe-harbor statutes (US) illustrate methods to protect users without smothering new platforms. This balancing act requires continual dialogue: as blockchain standards evolve, regulators must update laws without unpredictable changes. The chapter's analysis underscores that too little certainty deters trade actors, but too much rigidity can "freeze" innovation in place. Future lawmaking must therefore weave together flexibility (e.g. tech-neutral language, sunset clauses) with enforceable norms to protect trade integrity.

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[398] CryptoSlate, U.S. Blockchain Regulatory Certainty Act Reintroduced (2025), https://cryptoslate.com/us-blockchain-certainty-act-2025.

[399] EU Blockchain Observatory and Forum, Regulatory Sandbox Report (2022), https://www.blockchain-observatory.ec.europa.eu/reports/regulatory-sandbox_en.

[400] Cato Institute, Overregulating Crypto Innovation: Risks and Remedies (2024), https://www.cato.org/blog/overregulating-crypto-innovation.

[401] European Securities and Markets Authority (ESMA), Final Report on MiCA Implementation (2023), https://www.esma.europa.eu/sites/default/files/library/esma_final_mica_report_2023.pdf.

6.4 Future Research Roadmap

Building on the above findings, the dissertation identifies several key avenues for further scholarship:

- **Private International Law and Conflict of Laws:** Blockchain's cross-border nature raises unresolved jurisdictional questions. Who is the "maker" or "place of performance" of a decentralized transaction? As Zimmermann notes, a blockchain network does not fit neatly into traditional legal personhood, so existing conflict-of-laws rules (e.g. Rome I/II in the EU) may not automatically apply. Research should fill this doctrinal gap: for instance, proposing criteria to determine applicable law for smart-contract disputes (e.g. by parties' domicile, the blockchain node location, or the governing law clause of a hybrid contract). The broader "code-as-law" issue also merits study: scholars should analyze how norms embedded in smart contracts (which execute automatically) interact with statutory law – for example, whether on-chain "voting" procedures might be treated as constitutions of new legal entities, or how to reconcile immutable code with later legislative change.

- **Legal vs. Technical Normativity ("Code is Law"):** As Lessig's theory suggests, software code can enact rules de facto. Future work should critically examine this dynamic in trade. Does the autonomy of code require new regulatory oversight (e.g. standards for smart-contract auditing)? Might there be a need for meta-regulations to ensure that critical values (fairness, transparency, consumer rights) are "hard-coded" correctly? Comparative studies of jurisdictions (some of which have passed "smart contract" laws, others which treat them as ordinary contracts) could clarify whether and how "private blockchain rules" should be subject to public legal review.

- **Empirical Trade Impact Studies:** There is a dearth of hard data on blockchain's effects on trade volumes and costs. Economists and trade scholars should undertake quantitative analyses using real-world data. Possible approaches include case studies of supply chains before/after blockchain adoption (measuring time-to-payment, incidence of fraud, number of intermediaries, etc.) or econometric studies estimating how trade flows change

when parties adopt blockchain-based document platforms. For example, one could compare the number of days from shipment to payment in trade finance with blockchain systems versus traditional systems. Researchers should also assess broader macro effects: do economies that digitize trade documents (per UNCITRAL MLETR) see higher trade growth or SME participation? Preliminary reports (e.g. by APEC) suggest potential multi-billion-dollar gains from paperless trade, but rigorous ex-post studies are needed to validate and quantify these projections.

- **Judicial Responses and Case Law:** As blockchain litigation emerges, scholars should catalog and analyze relevant cases. To date, courts have generally held that smart contracts require traditional legal elements to be binding. However, future disputes will test this conclusion in diverse contexts: for instance, enforcement of delivery-versus-payment smart contracts in cross-border sales, or liability when on-chain execution causes loss (e.g. a smart-contract "bug" causing erroneous shipment). Research should track how national courts and arbitral tribunals are handling cryptocurrency and blockchain disputes (e.g. whether they recognize ledger entries as evidence, how they resolve conflicting ledgers, etc.). This could involve comparative studies of judicial treatment in major trade jurisdictions (e.g. U.S., EU member states, China, Singapore). Understanding these judicial trends will inform whether new legislation is needed to clarify enforceability of smart contracts and blockchain records.

6.5 Blockchain, WTO Agreements, UNCITRAL Model Laws and Treaty Coordination

Finally, the research evaluated how blockchain interacts with existing international trade law and how global coordination can be advanced:

- **WTO Agreements:** Blockchain has the potential to facilitate many WTO obligations. For example, under the *Trade Facilitation Agreement (TFA)*, members must streamline customs procedures (advance rulings, risk management, authorized operators, etc.). As Burri et al. explain, a blockchain-based customs platform could store advance rulings on a shared ledger accessible to all authorities (TFA Art. 3) and trigger smart contracts for

expedited release once conditions are met (Art. 7.1–7.8).[402] Real-time sharing on a tamper-proof blockchain could improve risk assessment and post-clearance audits (TFA Art. 7.4–7.5), and even automate licenses and temporary admissions (Art. 10.4, 10.9). Pilot projects (e.g. an EU–ICC proof of concept on ATA carnets, Korea's blockchain customs initiative, and the "Cadena" platform for AEO data) already illustrate these uses. Similarly, blockchain can aid *rules of origin* compliance: secure traceability ledgers could simplify determination of origin for preferential tariffs. Blockchain also complements the *TRIPS Agreement* by enabling IP right-holders to link goods to provenance data, facilitating customs enforcement under Articles 51–52 (as brands embed tokens or QR codes in products). In short, blockchain can help members fulfill existing WTO obligations – but only if the necessary legal recognition is in place and multi-party platforms are allowed.

The *General Agreement on Trade in Services (GATS)* has less direct connection, but could still be affected. Many service commitments (e.g. financial, logistics and IT services) already contemplate electronic provision across borders. In theory, DLT could fall under GATS Mode 1 (cross-border supply) for financial technology services or Mode 3 (commercial presence) if a foreign fintech establishes a branch. Importantly, GATS disciplines on cross-border trade could be invoked if one Member restricts use of blockchain-based contracts or cryptocurrencies used for payment in transacting digital services. Future work should examine whether GATS (and its negotiations on e-commerce) needs clarifications about blockchain and whether any non-discrimination clauses (e.g. Art. XIVbis concerning finance) apply to DLT innovations.

- **UNCITRAL Model Laws:** The 2017 Model Law on Electronic Transferable Records (MLETR) is directly on point: it creates a legal framework for electronic bills of lading, promissory notes and other "transferable documents", making them *functionally equivalent* to paper under four conditions (identification, control, integrity, etc.). [403]Because MLETR is technology-

[402] Burri, Mira et al., Blockchain in Trade Facilitation: Legal Challenges, 23 J. Int'l Econ. L. 407 (2020), https://www.cambridge.org/core/journals/journal-of-international-economic-law/article/blockchain-in-trade-facilitation-legal-challenges.
[403] UNCITRAL, Model Law on Electronic Transferable Records (MLETR) (2017), https://uncitral.un.org/sites/uncitral.un.org/files/media-documents/uncitral/en/mletr_ebook_e.pdf.

neutral, it explicitly permits distributed ledgers or token-based registries to satisfy these requirements. In effect, MLETR invites countries to amend national law so that blockchain systems can underpin digital trade documents. As noted above, Singapore's recent legislation (Electronic Transactions Amendment Act 2021) has done exactly this for e-bills of lading. By contrast, the earlier UNCITRAL Model Law on Electronic Commerce (MLEC, 1996) provides general support for e-contracts and e-signatures but does not cover transferable records. Future scholarship should analyze how national implementations of MLETR (and MLEC) align, and whether further UNCITRAL soft law (e.g. guidance on interoperability of blockchain platforms) is needed.

- **Future Treaty-Level Coordination:** Given the cross-border nature of blockchain, international coordination is crucial. One approach is to integrate blockchain considerations into *digital trade agreements* (DTAs) and e-commerce negotiations. For example, new Digital Economy Agreements (DEAs) like the Digital Economy Partnership Agreement (DEPA) between Singapore, Chile and New Zealand – open to all WTO members – could incorporate chapters on electronic documents and cross-border blockchain platforms.[404] Similarly, the UK–Singapore Digital Economy Agreement includes data and cyber chapters that could be models for blockchain- related provisions. On the multilateral front, the ongoing WTO Joint Statement Initiative on e-commerce could explicitly address blockchain standards or mutual recognition of e-records. The African Continental Free Trade Area's forthcoming digital trade protocol (Phase III) is a prime example: it is expected to use MLETR as a model and establish binding rules for e-transfers of records across member states. In addition, industry-driven forums (e.g. ICC Digital Standards Initiative) are working on global interoperability standards for e-B/Ls and smart contracts; scholars should evaluate how such private codes might be anchored in treaties or international guidelines.

In sum, Chapter 6 concludes that the legal architecture for blockchain in trade is evolving but incomplete. Existing treaties (TFA, TRIPS, WTO rules) are broadly

[404] World Economic Forum, Digital Economy Agreements and Trade Facilitation (2023), https://www.weforum.org/agenda/2023/03/digital-economy-trade-facilitation-standards.

compatible with DLT as a tool, but often lack explicit provisions on digital execution. UNCITRAL's model laws provide templates that many jurisdictions are starting to adopt. To fully realize blockchain's benefits, future treaty-level initiatives – whether through WTO, UNCITRAL, or regional e-commerce agreements – should explicitly endorse blockchain-based trade documents and harmonize cross-border rules. Doing so will align international law with the technological trajectory identified in earlier chapters, ensuring that regulatory frameworks support, rather than hinder, the next generation of digital trade.

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APPENDIX

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CERTIFICATE ON PLAGIARISM CHECK

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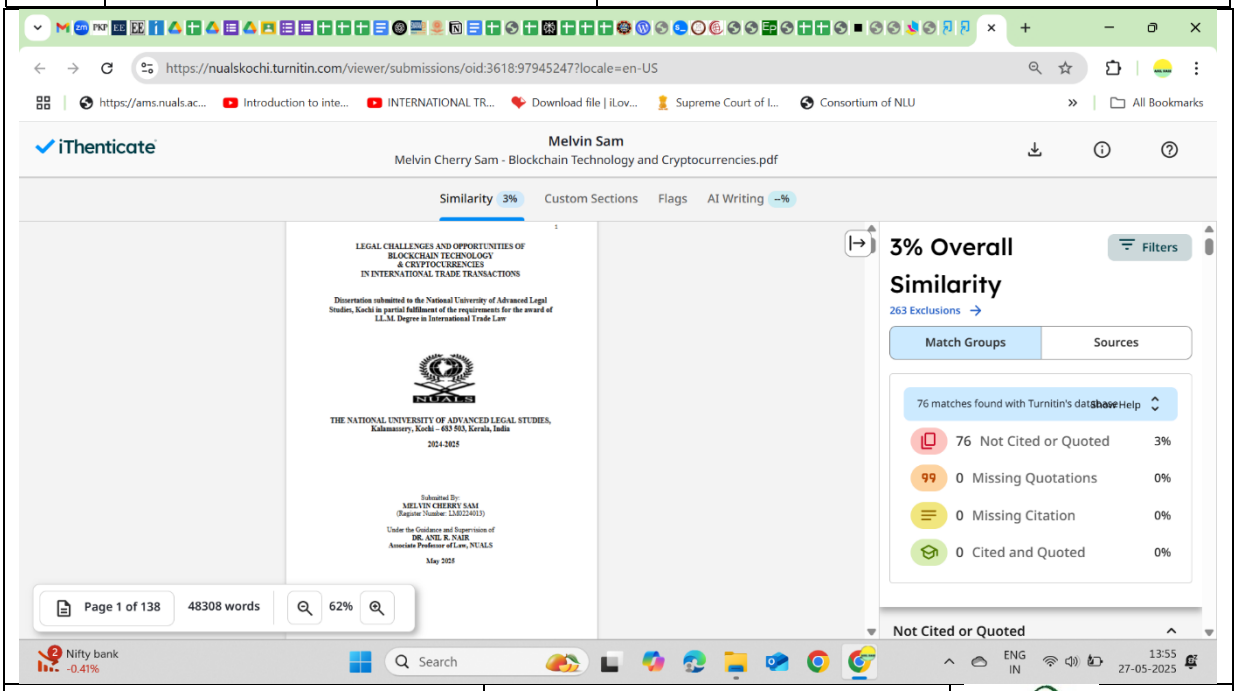

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