


# Chapter 15


## Cryptocurrency and Blockchain Forensics Tracing Digital Transactions

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### ABSTRACT

*This chapter explores the evolution and significance of blockchain forensics within the broader context of cryptocurrency adoption. It examines the technical foundations of blockchain, including pseudonymity, immutability, and transparency, and explains how investigative methods such as transaction mapping, clustering, and deanonymization are used to trace illicit activity. Key forensic tools and platforms, both commercial and open-source, are reviewed alongside the growing role of artificial intelligence. The discussion highlights critical challenges ranging from privacy coins and mixers to cross-border jurisdictional barriers and ethical dilemmas, and*

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*underscores the limitations of current forensic methods. The chapter also analyzes legal and regulatory frameworks, global cooperation, and emerging technologies like quantum computing, emphasizing the need to balance forensic capability with privacy protection and financial innovation.*

## **1. INTRODUCTION**

Cryptocurrencies have evolved from niche digital assets into a worldwide financial phenomenon in the last decade (Hossain, 2021; Koshelev, 2022). Bitcoin, Ethereum, and an increasing number of alternative tokens are now being used in mainstream commerce, investment, and cross-border payments. Their decentralized nature, built on blockchain technology, has unmatched benefits in terms of transparency, efficiency, and security (Alzoubi, 2024; Kukman & Gričar, 2025a). However, it has also created a parallel ecosystem of illicit activity. Since cryptocurrencies are pseudonymous and can be easily transferred around the world, they have become a preferred tool for cybercriminals, money launderers, ransomware operators, and darknet marketplaces. This duality - its legitimate financial innovation, and potential as an enabler of crime - underscores the pressing need for effective forensic techniques.

In the classical financial systems, centralised accounting, banking compliance, and regulatory auditing are a few of the mechanisms that control and deter fraudulent activity. On the other hand, decentralized financial ecosystems don't have these centralized enforcement mechanisms. While the immutability and transparency of blockchain ledgers provide useful data, the challenge is in tying pseudonymous transactions to real-world identities and reconstructing complex transaction flows involving multiple intermediaries, obfuscation techniques, and cross-chain interactions (Abdennadher et al., 2022; Alamsyah et al., 2024; Ozili, 2022). This has made forensic investigation a pillar of digital financial systems' trust and integrity.

Blockchain forensics has thus become a critical field at the intersection between cybersecurity, finance, and law enforcement. Its main goals are to trace, attribute, and analyze cryptocurrency transactions for financial crime investigation, regulatory compliance, and judicial processes. In addition to crime prevention, blockchain forensics also plays a wider role in improving market transparency, safeguarding investors, and helping build secure digital economies (Agarwal et al., 2024; Atlam et al., 2024; Dudani et al., 2023; Igonor et al., 2025). As governments and regulators flounder with the delicate balance between innovation and security, forensic capabilities offer a much-needed base for both enforcement and policymaking.

The goal of this chapter is to offer a thorough discussion of cryptocurrency and blockchain forensics. It draws attention to the development of cryptocurrencies as both legitimate instruments and vehicles for abuse, looks at the critical importance

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