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Cryptocurrencies in E-commerce: An Assessment of Their Integration into Online Shops, Shop Systems and Payment Service Providers

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Abstract:

The rapid digitalization of commerce has fundamentally transformed the landscape of payment systems. Cryptocurrencies, originally conceived as speculative investment assets, have gradually evolved into instruments considered for real-world transactions, especially in online retail. This study provides a systematic assessment of the integration of cryptocurrencies in e-commerce by focusing on three essential actor groups: online shops, shop-system providers, and payment service providers (PSPs). A systematic literature review following the PRISMA 2020 protocol was conducted across EBSCO, Scopus, and Google Scholar, supplemented by targeted desk research on prominent market players such as Newegg, Shopify, BitPay, PayPal, and Checkout.com. Quantitative adoption indicators from Chainalysis (2024), the European Central Bank (2024), and Capital One Shopping Research (2024) were incorporated to substantiate empirical observations. The results show that the use of cryptocurrencies as a payment method in e-commerce remains limited to technologically progressive and internationally active merchants. A conceptual Integration-Level Framework is proposed to explain adoption intensity as a function of technological readiness, regulatory maturity, and trust level among stakeholders. While cryptocurrencies promise efficiency, speed, and cross-border advantages, their broader diffusion is still constrained by volatility, heterogeneous regulation, and insufficient consumer trust. The paper concludes that long-term success will depend on regulatory stability—particularly the implementation of MiCA within the EU—alongside user education and improved usability.

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Introduction

The growing digitalization of financial transactions and the expansion of global e-commerce have triggered an unprecedented wave of innovation in payment systems. Cryptocurrencies such as Bitcoin, Ethereum, and stablecoins embody this change, offering decentralized, borderless, and transparent transaction mechanisms. Once regarded primarily as speculative assets, they are now gradually entering the mainstream of digital payments and drawing the attention of merchants, consumers, and regulators like (Adewole et al., 2020; Kim & Kim, 2022).

Despite their potential, the current level of adoption remains uneven and relatively low. While large, technology-oriented online shops and service providers have begun to experiment with cryptocurrency payments, mainstream e-commerce continues to rely on traditional intermediaries. Research identifies both drivers—such as lower transaction costs, security, and global reach—and persistent barriers, including regulatory ambiguity, technological complexity, and consumer trust deficits (El Chaarani, 2024; Shahzad, 2024).

Merchants are confronted with a delicate balance: adopting cryptocurrencies may provide differentiation and operational advantages but also introduces volatility and compliance risks. Consumers, in turn, associate crypto payments with innovation yet often perceive them as unstable, technically demanding, or legally uncertain (Namahoot, & Rattanawiboonsom, 2022; Sangari & Mashatan, 2024). Shop-system providers act as mediators by embedding crypto options through plugins and APIs, while PSPs increasingly function as gatekeepers of trust, ensuring regulatory compliance and technical interoperability between fiat and crypto ecosystems.

Existing studies predominantly focus on isolated aspects—technological feasibility, user perception, or regulatory constraints—without integrating these perspectives into a comprehensive analytical model. Consequently, a holistic, multi-actor approach is needed to understand how cryptocurrencies are embedded in the broader e-commerce ecosystem.

The objective of this study is therefore threefold: First, to map the current state of cryptocurrency integration within e-commerce; second, to identify the main technological, regulatory, and behavioral determinants that influence adoption across stakeholders; and third, to develop a conceptual framework that explains the interdependence of these determinants.

This leads to the following guiding research questions:

RQ1: Which factors influence the integration and acceptance of cryptocurrencies as payment methods in e-commerce from the perspective of merchants, shop systems, and payment service providers?

RQ2: How do these factors interact to determine levels of adoption and market penetration?

RQ3: Which regulatory and technological conditions are necessary for wider diffusion?

To address these questions, this paper combines a systematic literature review with desk research of leading industry actors. Section 2 explains the methodology, including database search parameters and selection criteria. Section 3 presents the literature review organized by thematic perspectives—consumer, merchant, regulatory, and international. Section 4 introduces empirical findings and the proposed conceptual Integration-Level Framework. Section 5 deals with theoretical and practical implications, and Section 6 contains the conclusion. Section 7 deals with the limitations of the research and perspectives for future research.

Materials and Methods

Research Design

To answer the research questions, a two-stage methodological design was applied. First, a Systematic Literature Review (SLR) following the PRISMA 2020 guidelines was conducted to identify, evaluate, and synthesize relevant academic work. Second, the findings were complemented by desk research that analyzed representative market actors in e-commerce providing cryptocurrency payment options. This mixed-method approach ensures methodological transparency and allows for both theoretical and practical insights into the adoption process.

Search Strategy and Databases

The systematic literature review was conducted between April and June 2025 using three major academic databases: EBSCOhost, Scopus, and Google Scholar. Boolean search strings combined relevant keywords—“cryptocurrency payment” AND (“e-commerce” OR “online shopping”) AND (“service provider” OR “merchant”)—to identify studies addressing cryptocurrency adoption and payment integration (see table 1). To ensure coverage of the most recent post-COVID developments in digital payment systems, the time frame was restricted to publications from 2020 to 2025. Only peer-reviewed journal articles, conference proceedings, and book chapters in English were considered.

Inclusion and exclusion criteria were applied to ensure methodological rigor and thematic relevance. Studies were included if they examined cryptocurrency adoption, payment integration, or stakeholder perspectives (consumers or merchants). Non-academic reports, press articles, and purely technical blockchain papers without adoption or payment context were excluded. The search yielded 213 records; after removing 115 duplicates, 98 unique articles were screened by title and abstract. Following full-text assessment, 40 studies met all inclusion criteria and were included in the qualitative synthesis (see figure 1).

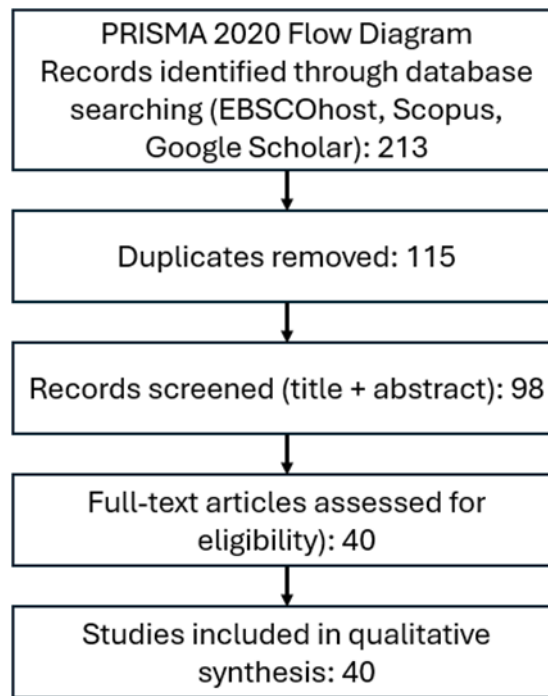


Figure 1: PRISMA 2020 Flow of Information through the Systematic Review

Criterion	Inclusion	Exclusion	Applied Rationale
Publication Type	Peer-reviewed journals, conference papers, book chapters	Non-academic reports, news articles	Ensures scientific rigor
Language	English	Other languages	Accessibility and comparability
Time Frame	2020-2025	Pre-2020 studies	Focus on post-COVID payment developments
Thematic Focus	Crypto adoption, payment integration, merchant/consumer perspective	Purely technical blockchain or mining papers	Relevance to research questions

Quality Assessment Indicators	Conceptual clarity, methodological design, data transparency	Missing methodology or anecdotal claims	Methodological reliability
Number of Studies Included	40 peer-reviewed sources (see reference list)	-	-

Table 1: Studies addressing cryptocurrency adoption and payment integration

Desk Research

Desk research was conducted to complement the SLR with real-world evidence. The focus was on leading e-commerce players offering or piloting crypto payments between April and August 2025.

Three actor groups were analyzed:

- Online shops: Newegg, NordVPN, Namecheap, Cyberport.
- Shop systems: Shopify, WooCommerce, Shopware, Magento.
- Payment service providers (PSPs): BitPay, Coinbase Commerce, NOWPayments, PayPal, Stripe, Checkout.com.

The cases were selected based on market relevance, innovation level, and availability of public data. Information was verified using official corporate websites, annual reports, and market analyses.

Literature Review

To improve conceptual clarity and respond to reviewer feedback, the literature review is structured into four thematic subsections.

Consumer Perspective

Consumers' willingness to use cryptocurrencies for payments depends primarily on perceived usefulness, risk, and trust. The Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) provide the theoretical foundation for this analysis. Recent studies confirm that trust is the decisive mediator between perceived benefits and behavioral intention (Namahoot, & Rattanawiboonsom, 2022, Sham et al., 2025, Zarifis, 2023). The CRYPTOTRUST 2 model extends consumer trust theory to crypto-payments by incorporating perceived risk and digital-brand association (Zarifis & Fu, 2024). Empirical studies show that security, privacy, and transparency foster positive attitudes, whereas volatility and lack of awareness generate skepticism (Babu, 2024, Seshadrinathan & Chandra, 2025; Shahzad, 2024).

Furthermore, empirical research shows that perceived security, privacy, and transparency positively influence consumer attitudes, whereas volatility, lack of knowledge, and psychological resistance have negative effects (Babu, 2024; Sangari & Mashata, 2024). Despite global awareness, actual adoption remains low because most users still perceive cryptocurrencies as speculative rather than practical instruments (Shahzad et al., 2024). Empirical findings from the United States indicate that despite awareness, consumer adoption remains weak due to branding, usability, and perceived value gaps (Kowalski et al., 2018). Hence, consumer trust functions as a cornerstone for mass adoption and connects individual attitudes with institutional credibility. Recent studies also reveal that social-network-backed cryptocurrencies may benefit from existing digital trust mechanisms and reduce initial user resistance (Recskó & Aranyosy, 2024). Blockchain-based mechanisms for decentralized reputation management can further enhance trust and reduce asymmetric information between buyers and sellers (Gonçalves et al., 2022).

Merchant Perspective

From a merchant's standpoint, adopting cryptocurrency payments can offer transaction-cost reductions, faster settlement, and marketing differentiation. However, the integration process requires technical expertise and regulatory understanding that small and medium-sized enterprises often lack. Existing research indicates that adoption is concentrated among technology-driven firms seeking early-adopter advantages (Bezovski et al., 2021; Wohllebe, 2022; Wu, 2022). The application of blockchain in e-commerce is expanding rapidly, yet its scalability and interoperability remain major adoption challenges (Karani & Mwapwele, 2023). Systematic evidence confirms that most merchants still face integration barriers due to system incompatibility and transaction volatility (Roopnarain & Mwapwele, 2025). Blockchain integration may also transform value creation and transparency across the e-commerce supply chain, potentially strengthening merchant competitiveness (Nikivorov, 2024).

Barriers include exchange-rate volatility, unclear tax treatment, and consumer demand uncertainty (El Chaarani et al., 2024). In countries with supportive regulations and fintech ecosystems, such as the US or Estonia, merchants have been more willing to integrate crypto payments, while German and EU markets show slower adoption due to stronger compliance requirements (Derindağ, 2022).

Regulatory Challenges

Legal uncertainty remains one of the strongest deterrents for both merchants and PSPs. The Markets in Crypto-Assets Regulation (MiCA) adopted by the European Union in 2024 represents the first comprehensive attempt to harmonize rules across member states. MiCA defines licensing obligations for crypto-asset service providers, stablecoin issuers, and consumer protection standards.

In contrast, the U.S. Financial Crimes Enforcement Network (FinCEN) and the Monetary Authority of Singapore (MAS) apply fragmented but evolving approaches to AML/KYC compliance (Albshaier, 2024; Kovalchuk, 2024). Comparative research shows that markets with clear rules experience higher institutional trust and thus greater adoption levels (Koutrouli & Manousopoulos, 2025). European analyses highlight that fraud prevention and regulatory fragmentation remain major obstacles to the institutionalization of crypto payments (Sanz-Bas et al., 2021).

International Applications

Regional differences highlight the context-specific nature of crypto adoption. Regional case studies such as Saudi Arabia illustrate how cultural and religious factors influence the perceived legitimacy of cryptocurrency in online commerce (Hajr et al., 2023). Recent global perception studies also confirm that awareness and ownership patterns vary considerably across regions, reflecting distinct socio-economic and cultural contexts (Murugappan et al., 2023). In China and the United States, usage is driven by technological infrastructure and payment innovation, while in Eastern Europe (e.g., Ukraine, Romania) it is often

Stablecoins such as USDT and USDC have been introduced to reduce price volatility and facilitate cross-border trade (Vynogradova et al., 2024). Quantitative data (Chainalysis, 2024) indicate that cryptocurrency payments still account for less than five percent of global e-commerce transactions, confirming that mainstream diffusion has yet to occur.

Results

Empirical Findings

The desk-research results demonstrate that the integration of cryptocurrencies into e-commerce remains at an early stage and is primarily limited to innovative and internationally active companies. Among online merchants, technology-oriented firms such as Newegg (Newegg, 2025), NordVPN (NordVPN, 2025), and Namecheap (Namecheap, 2025) have successfully introduced cryptocurrency payments to address tech-savvy and privacy-conscious customers. Their adoption strategies focus on differentiation and marketing effects rather than on cost savings. In contrast, traditional retailers—particularly in German-speaking markets—are still reluctant to implement crypto payment options. For instance, Cyberport (Cyberport, 2025) accepts cryptocurrencies only indirectly via intermediaries such as Bitrefill (Bitrefill, 2025).

Shop-system providers play a crucial role as technological multipliers. Shopify (Shopify, 2025) and WooCommerce (WooCommerce, 2025) have established the most comprehensive plugin ecosystems, offering ready-to-use integrations with BitPay (BitPay, 2025), Coinbase Commerce (Coinbase

Commerce, 2025), and Cryp-to.com Pay (Crypto.com Pay, 2025). Shopware (Shopware, 2025) and Adobe Commerce (Adobe Commerce, 2025) (Magento) focus more on B2B-oriented customization and provide limited native support for cryptocurrencies. By lowering integration barriers, shop-systems enable small and medium-sized retailers to experiment with crypto payments without major infrastructural investment.

Payment-service providers (PSPs) act as institutional bridges between fiat and crypto ecosystems. The analysis distinguishes between crypto-native PSPs—such as BitPay, Coinbase Commerce, and NOWPayments (NOWPayments, 2025)- and traditional PSPs like PayPal (PayPal, 2025), Stripe (Stripe, 2025), and Checkout.com, which are only beginning to test stablecoin and Web3 functionalities. According to secondary data from industry reports (Chainalysis, 2024, p. 23; Capital One Shopping Research, 2024, Table 2), the total share of online merchants accepting cryptocurrencies worldwide was reported to remain below 0.7 %. The same sources indicate an estimated year-over-year transaction growth of approximately 47 % between 2024 and 2025 (Capital One Shopping Research, 2024; Chainalysis, 2024). These data illustrate both the limited penetration and the dynamic momentum of crypto-payment solutions. All numerical indicators in this paper are based on secondary data. No primary data collection or computation was conducted.

Integration-Level Framework

The findings from the literature review and the empirical desk research converge in the conceptual Integration-Level Framework shown below. This framework models the interaction between three key dimensions—Technological Readiness, Regulatory Maturity, and Trust Level—which jointly determine the overall Adoption Intensity of cryptocurrencies in e-commerce. Similar technological models emphasize API-based architecture and interoperability as prerequisites for efficient crypto-payment integration (Navarro et al., 2024).

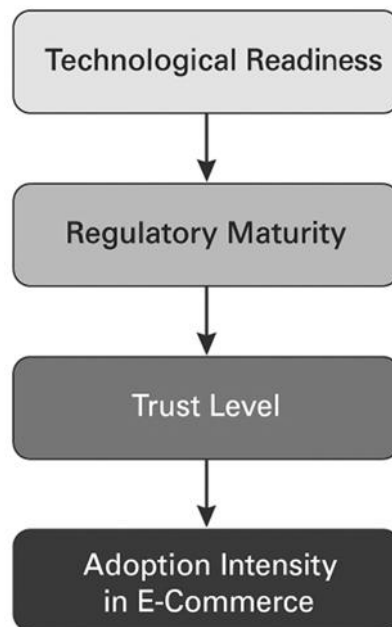


Figure 2: Elaboration based on Chainanalysis, ECB & Capital One Shopping Research (2024)

Figure 2 illustrates the following interpretation: Technological Readiness (TR) captures the maturity of the underlying IT infrastructure, including API connectivity, block-chain scalability, and plugin compatibility. Regulatory Maturity (RM) measures the clarity and enforceability of legal frameworks, particularly concerning AML/KYC requirements and taxation rules. Trust Level (TL) represents consumer and merchant confidence in the stability, legitimacy, and usability of crypto payments. High TR, RM, and TL jointly result in strong adoption intensity. If any of these dimensions is weak—e.g., unclear regulation or low consumer trust—adoption remains marginal.

It should be emphasized that the Integration-Level Framework (ILF) presented in this study is conceptual in nature. While selected secondary indicators from Chainanalysis (2024), ECB (2024), and Capital One Shopping (2024) were used to illustrate its dimensions, these data serve solely as contextual evidence rather than empirical validation. Future research should operate the ILF quantitatively and test it empirically across different markets.

Discussion

Theoretical Integration

The empirical results confirm and extend existing technology-acceptance theories (see table 2).

Dimension	Technology– Organization–	Integration-Level Framework (ILF)	Extension / Novel Contribution
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	Environment (TOE) Framework		
Analytical Level	Firm / organizational	Multi-actor (merchant – PSP – shop system)	Expands scope beyond single organization
Core Constructs	Technological, Organizational, Environmental factors	Technological Readiness, Regulatory Maturity, Trust Level	Replaces “organizational” with inter-organizational trust dimension
Regulatory Context	Environment implicit (external pressures)	Regulation explicit (legal harmonization as determinant of adoption)	Introducing regulatory maturity as new measurable factor
Empirical Validation	Widely tested across IS adoption studies	Conceptual model derived from crypto-payment context	Adapts TOE for FinTech ecosystems
Theoretical Contribution	Framework for innovation diffusion	Integrated model linking behavioral trust and institutional readiness	Bridges micro- and macro-levels of adoption

Table 2: Theoretical Comparison: TOE vs. Integration-Level Framework (ILF)

In line with the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), it perceived usefulness and trust significantly influence behavioral intention. Current FinTech research further supports this view. Trust has been identified as the dominant factor for the acceptance of FinTechs in emerging markets (Seshadrinathan & Chandra, 2025). This is consistent with similar findings from studies on cryptocurrencies (Babu, 2024, Shahzad et al., 2024). However, this study advances the discussion by incorporating an institutional dimension: payment-service providers emerge as trust brokers, mediating between technological feasibility and regulatory compliance. The proposed Integration-Level Framework therefore complements prior individual-level models with an inter-organizational perspective that reflects the complex triad of actors in e-commerce.

Actor-Specific Insights

For merchants, the decision to adopt cryptocurrencies is shaped by target-group alignment, brand positioning, and the potential for market differentiation. Large, tech-focused firms view crypto payments as a marketing innovation rather than as a financial necessity. Smaller retailers remain cautious, citing volatility, tax complexity, and integration costs as main barriers (El Chaarani et al., 2024).

Shop-System Providers. These actors function as technological catalysts. By offering modular integration via APIs or plugins, they reduce technical entry barriers for merchants. Nevertheless, adoption on shop-system platforms still depends on user demand and the availability of compatible PSP solutions.

Payment Service Providers (PSPs) represent the institutional backbone of cryptocurrency integration and reveal contrasting strategies between traditional and crypto-native actors. Traditional PSPs such as PayPal and Stripe follow cautious pilot programs focused on compliance, reputation, and risk control under strict financial regulation. Conversely, crypto-native PSPs like BitPay, NOWPayments, and Coinbase Commerce expand aggressively, leveraging technological flexibility and early-adopter communities to test Web3 features and multi-token payment solutions. While this agility fosters innovation, it also entails higher operational and regulatory risks. The resulting competitive tension illustrates that institutional trust and regulatory positioning—rather than mere technological capability—ultimately determine the pace and direction of cryptocurrency adoption in e-commerce (Koutrouli & Manousopoulos, 2025).

Regulatory and Market Implications

The comparative regulatory analysis reveals that the EU MiCA Regulation (2024) provides the most comprehensive and harmonized framework worldwide, covering stablecoins, service-provider licensing, and consumer protection. In contrast, the U.S. FinCEN system remains fragmented, while the Monetary Authority of Singapore (MAS) applies a sandbox approach encouraging innovation under controlled conditions. Markets with clearer and more predictable regulatory environments show higher institutional trust and faster diffusion. Security enhancements through blockchain based mobile-payment architecture further illustrate how technological design contributes to trust and compliance (Rattanawiboonsom, & Khan, 2024). Accordingly, the EU's MiCA Regulation (2024) has been described by several commentators (e.g., Koutrouli & Manousopoulos, 2025; ECB 2024, p. 18) as one of the most comprehensive frameworks to date. However, this characterization reflects regulatory ambition rather than empirical performance benchmarking, as MiCA's implementation outcomes remain to be assessed (see table 3).

Dimension	EU (MiCA 2024)	USA (FinCEN Guidance)	Singapore (MAS Payment Services Act)
Scope of Regulation	Comprehensive: crypto-asset service providers, stablecoins, and market integrity	Fragmented: focus on AML/KYC and money transmission; state-by-state licensing	Broad coverage: digital-payment tokens and intermediaries
Licensing Requirements	Mandatory EU-wide CASP license, passporting rights	Limited; mainly fraud prevention	Requires safeguarding of customer assets and clear dispute resolution
Consumer Protection	Explicit disclosure & complaint procedures; reserve-asset requirements for stablecoins	Limited; mainly fraud prevention	Requires safeguarding of customer assets and clear dispute resolution
AML/KYC Framework	EU Anti-Money-Laundering Directive 6 (AMLD6) integration	Bank Secrecy Act + FinCEN rules	AML Notice 626 & risk-based obligations
Regulatory Maturity	High – harmonized EU framework 2024 onward	Medium – fragmented federal system	AML Notice 626 & risk-based obligations
Innovation Approach	Cautious – focus on stability and compliance	Reactive – case-by-case guidance	Proactive – sandbox and token classification clarity

Table 3: Regulatory Framework Comparison (MiCA / FinCEN / MAS)

Environmental and Ethical Considerations

Beyond financial and regulatory aspects, sustainability and ethical issues are gaining importance. Blockchain applications in financial services have evolved toward more energy-efficient and standardized frameworks that enhance transaction security (Javaid et al., 2022). The transition of major

networks—most notably Ethereum—to Proof-of-Stake has reduced energy consumption by over 95 % (European Central Bank, 2024). Blockchain applications span various e-commerce value-chain domains, from logistics transparency to payment verification (Witt & Schoop, 2024). Decentralized e-commerce transaction systems demonstrate how blockchain can replace intermediaries while maintaining transactional security (Xiao et al., 2022). Simultaneously, PSPs and merchants are compelled to strengthen AML/KYC processes to prevent misuse, which may challenge privacy-oriented users but enhances legitimacy in the long term. Balancing transparency and privacy thus remain a central ethical concern for future development.

Conclusion

Cryptocurrencies have progressed from a fringe technological experiment to an emerging payment option within global e-commerce ecosystems. This study systematically assessed the integration of cryptocurrencies by analyzing the roles of merchants, shop-system providers, and payment-service providers (PSPs). Through a systematic literature review and complementary desk research, the paper identified key determinants of adoption and introduced a novel Integration-Level Framework that explains adoption intensity as a function of technological readiness, regulatory maturity, and trust level.

The results show that while the technical prerequisites for integration are steadily improving, regulatory clarity and consumer trust remain decisive bottlenecks. The framework demonstrates that high levels of technological readiness alone are insufficient unless accompanied by consistent regulation and institutional credibility. The European Union's MiCA Regulation (2024) provides a promising model for harmonizing crypto-payment rules, while other jurisdictions are still catching up. In the longer term, the adoption of stablecoins and the rise of Web3-based financial services may accelerate mainstream diffusion, if security, privacy, and sustainability concerns are effectively addressed. Future developments are likely to align with ongoing global trends of digital-currency adoption in e-commerce ecosystems (Toureche et al., 2025).

The practical implications of this study emphasize the importance of coordinated action across regulatory, commercial, and consumer levels. For policymakers, the results underline the need for harmonized international regulatory frameworks that strike a balance between fostering innovation and ensuring investor protection. For merchants, cryptocurrencies offer opportunities for differentiation and cross-border expansion; however, strategic implementation should address volatility risks through mechanisms such as stablecoins and real-time conversion. For payment service providers, competitive advantages can be achieved through hybrid fiat-crypto models that preserve regulatory compliance while enhancing interoperability. Finally, for consumers, transparency, education, and digital financial literacy are essential to build trust and overcome psychological barriers toward crypto-based payment systems.

Beyond its practical relevance, this study also contributes to theory. The proposed Integration-Level Framework confirms key assumptions of the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) while extending them by introducing institutional and regulatory dimensions. The findings demonstrate that trust mediates the relationship between technological readiness and adoption intention, thereby integrating individual and organizational levels of analysis. This theoretical contribution helps to fill a persistent gap in the literature by connecting behavioral and institutional determinants of cryptocurrency adoption.

Limitations and Future Research

The study is subject to several limitations. First, it relies on secondary data and desk research rather than primary surveys or experiments, which limit statistical generalizability. Second, while the PRISMA-based literature review ensures methodological transparency, publication bias may persist because not all relevant studies are indexed in the selected databases. Third, regulatory environments evolve rapidly—particularly during the implementation of MiCA—so conclusions may need to be revisited as legal frameworks mature. Fourth, all quantitative indicators and regulatory assessments are based exclusively on secondary sources such as Chainalysis (2024) and ECB (2024). Their underlying methodologies differ, and their data should be interpreted as contextual reference points, not as directly comparable statistical measures.

The identified limitations also provide a direct foundation for future research. Because this study is based on secondary data, future studies should collect primary evidence to empirically validate the Integration-Level Framework. Furthermore, as regulatory contexts evolve rapidly (e.g., MiCA implementation), longitudinal research designs are needed to assess changing adoption patterns. Finally, since consumer trust and perception were derived from literature, qualitative and experimental studies could explore how these mechanisms develop in real e-commerce environments.

In addition, the environmental implications of emerging consensus algorithms and the role of sustainability reporting within payment ecosystems merit closer examination. Finally, empirical research should aim to operationalize and validate the proposed Integration-Level Framework through the development of measurable indicators and their application across diverse market environments.

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