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Entrepreneurial firms in the crypto era: adoption trajectories and innovation dynamics

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Abstract

Purpose – This study explores the dynamics of cryptocurrency adoption in entrepreneurial firms, focusing on how entrepreneurial traits, innovation dynamics and adoption challenges shape crypto-driven innovation. Unlike prior research on consumer adoption, this study examines unique factors influencing the adoption of small and medium entrepreneurial firms.

Design/methodology/approach – Based on the experiences of firm owners (entrepreneurs), managers and key stakeholders, a phenomenological qualitative approach investigates factors driving cryptocurrency adoption within entrepreneurial firms in Pakistan. The study is framed by the extended Technology-Organization-Environment-Innovation (TOE-I) framework and social cognitive theory (SCT). Semi-structured interviews and narrative analysis uncover key determinants and adoption trajectories.

Findings – Thematic analysis identifies critical factors influencing cryptocurrency adoption, including technological aspects (e.g. Know Your Customer (KYC) protocols, cybersecurity risks), organizational components (e.g. digital transformation assets) and environmental factors (e.g. the role of national and local government institutions and industry transitions). It also highlights the importance of innovation characteristics of entrepreneurs such as digital literacy, strategic networking and collaboration, adaptability and flexibility, and senior management (older employees) education. Additionally, the study outlines limitations and directions for future research about the conceptual framework.

Originality/value – This research enhances the understanding of crypto-driven innovation in entrepreneurial firms by integrating the TOE-I and SCT frameworks, offering a deeper theoretical perspective on technology adoption. It highlights how regulatory frameworks, cultural-religious considerations (e.g. Islamic rulings—fatwa and haram aspects of cryptocurrency), and social stigma intersect with SCT factors to influence adoption. Furthermore, the extended factor of entrepreneurial innovation characteristics within the TOE framework intersects with the self-efficacy and observation dimensions of SCT. The study provides actionable recommendations for policymakers, entrepreneurs and stakeholders to address adoption barriers, foster innovation and accelerate cryptocurrency integration.

Keywords Entrepreneurial characteristics, Entrepreneurial firms, Cryptocurrency adoption, Innovation factors, Blockchain technology, Qualitative analysis

Paper type Research paper

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1. Introduction

Since the emergence of Bitcoin in 2009, cryptocurrency has significantly transformed business operations by offering decentralized and secure digital financial alternatives (El Chaarani *et al.*, 2024; Urquhart and Yarovaya, 2023). Other popular cryptocurrencies such as Ethereum, Ripple, Litecoin, Neo and Tron have expanded the range of digital currencies, enabling businesses to make direct transfers without relying on traditional banking intermediaries (Conti *et al.*, 2018). These innovations streamline financial processes, provide an alternative to conventional currencies and enhance payment methods, substantially benefiting businesses (Koroma *et al.*, 2022).

Blockchain technology is at the core of cryptocurrency, a decentralized digital ledger secured through cryptographic techniques (Urquhart and Yarovaya, 2023). Transactions occur on cryptocurrency exchanges such as Binance, Coinbase and KuCoin, validated by a network of computers (nodes) using mining or other consensus mechanisms (Kumar and Rani, 2024). Cryptocurrencies like Bitcoin have a finite supply regulated by predetermined algorithms, stored in wallets secured by cryptographic keys, ensuring security, transparency and trust in peer-to-peer networks, thus contributing to a resilient global financial system (Udokwu *et al.*, 2021).

Cryptocurrency adoption addresses traditional financial challenges by enhancing transparency, reducing transaction costs and enabling efficient cross-border transactions and smart contract automation (Saiedi *et al.*, 2021). However, despite growing institutional interest, cryptocurrency adoption among entrepreneurial firms—especially small and medium—remains limited. This suggests that significant barriers prevent full-scale adoption despite its potential benefits (Al-Amri *et al.*, 2019).

Entrepreneurial firms, characterized by their focus on innovation, risk-taking and adaptability, are uniquely positioned to adopt new technologies (Abaddi, 2024a; López-Muñoz *et al.*, 2023; Sitaridis and Kitsios, 2022). However, regulatory uncertainty, perceived price volatility and technical complexities hinder widespread cryptocurrency adoption (Schaupp and Festa, 2018). In particular, entrepreneurs' characteristics—such as risk tolerance, digital innovation and openness to new technologies like blockchain—are critical to determining adoption decisions (Abaddi, 2024a). In developing economies, digital literacy gaps, regulatory uncertainties and perceived risks present significant obstacles to adoption (Islam *et al.*, 2023; Malik *et al.*, 2024).

Cryptocurrency usage varies based on objectives: individuals typically focus on investment and decentralized financial services, facing challenges like volatility and security risks (Jegerson *et al.*, 2023). In contrast, Bhimani *et al.* (2022) argued that entrepreneurial firms emphasize operational efficiency, particularly in cross-border payments, encountering issues such as integration costs, regulatory compliance, system integration and security protocols. Entrepreneurs in these firms also face challenges related to accessing digital transformation assets and fostering a culture of innovation (Islam *et al.*, 2023). While entrepreneurial firms benefit from blockchain autonomy and digital infrastructure, entrepreneurs in developing countries rely on individual capabilities to address these challenges (Abaddi, 2024b). Despite these obstacles, entrepreneurial mindsets remain key to overcoming barriers and leveraging opportunities in the digital currency space.

Scholarly research extensively covers blockchain technology and cryptocurrency, often focusing on Western contexts (Arias-Oliva *et al.*, 2019; Bhimani *et al.*, 2022) and diverse backgrounds (Taherdoost, 2022; Udokwu *et al.*, 2021). Studies frequently examine consumer behaviors and intentions toward adopting blockchain-based cryptocurrencies (Jegerson *et al.*, 2023; Koroma *et al.*, 2022). For instance, Chen *et al.* (2022) scrutinized individual engagement in cryptocurrency transactions, while Almajali *et al.* (2022) studied factors influencing consumer usage. Islam *et al.* (2023) explored determinants of cryptocurrency adoption, including consumer attitudes and awareness, and Al Reshaid *et al.* (2024) investigated intentions to adopt cryptocurrency for online shopping. However, these studies primarily focus on consumer behavior rather than adoption factors specific to businesses, industries and clientele.

Our study addresses this gap by examining the factors influencing cryptocurrency adoption within entrepreneurial firms and their customers' perceptions, particularly in developing

nations like Pakistan. In Pakistan, entrepreneurial firms are defined by characteristics such as an employee count of up to 250 and an annual turnover of up to PKR 800 million. These firms are vital to the country's economy, contributing significantly to employment generation and industrial growth (Nazir *et al.*, 2022). According to the Small and Medium Enterprise Development Authority SMEDA (2023), small firms typically employ up to 50 people with a yearly turnover of up to PKR 150 million, while medium firms employ 51 to 250 people with an annual turnover ranging from PKR 150 million to PKR 800 million. Despite their economic significance Nazir *et al.* (2024a) argued that these firms face challenges such as limited access to financing for technological advancements, regulatory hurdles and technological constraints.

The integration of cryptocurrency in Pakistan faces several barriers, particularly for younger, tech-savvy entrepreneurs seeking innovative financial solutions (Malik *et al.*, 2024). Regulatory uncertainty and the absence of a clear legal framework hinder widespread adoption, while cultural and religious concerns further limit acceptance. However, opportunities exist in the form of increasing digital literacy and the potential for blockchain technology to enhance financial inclusion and facilitate cross-border transactions. This highlights the need for comprehensive research to explore how entrepreneurial firms in developing nations can adopt cryptocurrencies and navigate both internal and external challenges. Our study aims to answer the following research questions:

(1) What factors impede entrepreneurial firms from adopting cryptocurrency innovation?

(2) How do entrepreneurial characteristics influence cryptocurrency adoption in firms?

The study employs qualitative phenomenological research methods, using the extended Technology-Organization-Environment (TOE) framework (Tornatzky and Fleischer, 1990), supplemented by social cognitive theory (SCT) (Bandura, 1986), to explore these factors. The research provides valuable insights into the adoption barriers and strategies for overcoming challenges within Pakistan's digital economy. By exploring the intersection of entrepreneurial traits, innovation dynamics and cryptocurrency adoption, this study contributes to both the entrepreneurship and innovation literature, offering actionable recommendations for different stakeholders to foster digital transformation.

This paper begins by introducing the research context, gaps and objectives. It then reviews relevant literature based on the extended TOE-I and SCT framework. The methods section outlines the research design, followed by a presentation of the findings and thematic analysis. Finally, the discussion leads to the conclusions, highlighting the study's theoretical and practical contributions and offering recommendations for enhancing cryptocurrency adoption in entrepreneurial firms.

2. Literature review

2.1 Global adoption of cryptocurrency innovation

The adoption of cryptocurrency innovation has been a focal point of growing academic research, particularly as digital financial technologies continue to reshape business practices worldwide (Urquhart and Yarovaya, 2023). The role of entrepreneurial firms in adopting cryptocurrency is especially significant, as these firms are often early adopters of new technologies, offering a window into the challenges and opportunities presented by digital currencies (Al-Amri *et al.*, 2019; Chen *et al.*, 2022). This review synthesizes existing studies to examine the various factors and methodologies used to explore cryptocurrency adoption across global contexts (see Table 1). By comparing these studies, we identify common trends, regional discrepancies and evolving insights into the cryptocurrency adoption process within entrepreneurial firms.

Studies investigating cryptocurrency adoption span multiple markets with varying dynamics. In India, Kumar and Rani (2024) applied the Diffusion of Innovation theory and Partial Least Squares Structural Equation Modeling (PLS-SEM) to understand cryptocurrency

Table 1. Previous empirical studies on the cryptocurrency

Authors/ year	Country	Research background	Findings	Framework	Research methodology
Albayati *et al.* (2020)	Multiple	Customer-centric approach to accepting financial transactions via Blockchain technology	Trust, regulatory support, social influence, design and experience	TAM (Technology Acceptance Model)	Quantitative
Ali *et al.* (2020)	Multiple	Adoption of blockchain technology by consumers in the financial sector	Financial, regulations, operational and adoption challenges	Systematic literature review	Systematic Review
Kumar and Rani (2024)	India	Cryptocurrency as an investment and mode of transaction	Trialability, compatibility, complexity, observability and perceived value	DOI (Diffusion of Innovation), consumer behavioral theory	Quantitative
Al Reshaid *et al.* (2024)	Turkey	Consumers' intention to adopt cryptocurrency for online shopping behavior	Attitudes, subjective norms, consumer trust and financial literacy	TPB (Theory of Planned Behavior)	Quantitative
Chen *et al.* (2022)	Malaysia	Satisfaction of customers with cryptocurrency adoption in digital transactions	Social influence, transparency, price value, traceability and attitude (AT)	TAM, Expectancy-Disconfirmation Theory, Adoption Theories	Quantitative
El Chaarani *et al.* (2024)	France	Factors driving the adoption of cryptocurrencies for financial transactions among industry consumers	Ease of use, perceived usefulness, social influence and financial literacy	TAM, DOI, TRA (Theory of Reasoned Action), UTAUT (Unified Theory of Acceptance and Use of Technology)	Quantitative
Arias-Oliva *et al.* (2019)	Spain	Successful development of a cryptocurrency from a consumer behavior perspective	Perceived risk, willingness and performance expectancy	TAM	Quantitative
Jegerson *et al.* (2024)	UAE	Investigates internal factors influencing consumer adoption of cryptocurrencies for remittance transactions	Behavioral intention, perceived risk and consumer innovation	UTAUT2	Quantitative
Koroma *et al.* (2022)	Africa	Examines the influence of trust on citizens' decision-making behavior toward blockchain cryptocurrency	Trust, consumer behavior and ethical issues	Trust Transfer Theory	Quantitative

(*continued*)

Table 1. Continued

Authors/ year	Country	Research background	Findings	Framework	Research methodology
Sohaib *et al.* (2020)	Australia	Aims to answer questions regarding individual consumers' interest in cryptocurrency	Optimism, innovativeness, discomfort, insecurity, perceived ease of use and perceived usefulness	Technology Readiness, TAM	Quantitative
Huang (2019)	China	Impact factors on individuals' intention to hold Bitcoin, a cryptocurrency created by Blockchain technology	Understanding of the values and risks and less government intervention	Systematic literature review	Quantitative
Jegerson *et al.* (2023)	UAE	Exploring the adoption and usage of cryptocurrencies among customers in the UAE	Performance expectations, price value, hedonic motivation, and consumer innovativeness	TAM, UTAUT2	Quantitative
Al-Amri *et al.* (2019)	Malaysia	A systematic literature review to collect previous research related to cryptocurrency adoption	Multiple factors including human and security and subjective norms	Systematic literature review	Mixed methods

Source(s): Authors' own creation

adoption among retail consumer investors. The research highlights the critical role of regulatory frameworks, suggesting that clear regulations help mitigate the uncertainties and risks associated with adopting cryptocurrency. Similarly, in the UAE (United Arab Emirates), Jegerson *et al.* (2024) employed the Unified Theory of Acceptance and Use of Technology (UTAUT2) to explore internal factors influencing consumer adoption of cryptocurrencies, particularly for remittances. The study found that performance expectations and consumer innovativeness were key drivers of cryptocurrency adoption, particularly among tech-savvy populations.

In Australia, Sohaib *et al.* (2020) explored individual interest in cryptocurrencies using the Technology Readiness and Technology Acceptance Model (TRAM), identifying perceived ease of use and perceived usefulness as significant factors in consumer decision-making. On the African continent, a study by Koroma *et al.* (2022) focused on trust dynamics in adopting cryptocurrencies. They emphasized that building user trust is vital for fostering widespread adoption, especially in emerging markets. Similarly, in France, El Chaarani *et al.* (2024) noted that financial literacy and ease of use are significant in determining how consumers adopt and utilize cryptocurrency.

Despite these valuable insights, significant gaps remain, particularly regarding cryptocurrency adoption in underdeveloped contexts like Pakistan. Much of the existing research on cryptocurrency adoption has focused on consumer behavior (Al Reshaid *et al.*, 2024; Ali *et al.*, 2020; Albayati *et al.*, 2020) and in developed economies (Arias-Oliva *et al.*, 2019; Huang, 2019; Jegerson *et al.*, 2023), overlooking the unique socio-economic and

regulatory challenges that developing countries face. According to the Global Innovation Index (2023) report, Pakistan ranks 116th in innovation inputs globally, highlighting the country's struggle to adopt innovation effectively. Furthermore, there is a lack of research addressing entrepreneurs' innovation traits and how internal and external factors impact cryptocurrency adoption, particularly in the context of entrepreneurial firms.

Our study aims to fill this gap by examining cryptocurrency adoption within entrepreneurial firms in Pakistan. Unlike previous studies, which primarily employ quantitative approaches, our research uses a phenomenological qualitative methodology. This approach allows us to uncover the nuanced experiences of entrepreneurial firm owners and managers, focusing on their motivations, barriers and decision-making processes regarding cryptocurrency adoption. We aim to explore how cryptocurrency adoption can contribute to financial inclusion and enhance business operations within Pakistan's unique socioeconomic and regulatory environment.

Additionally, by integrating the TOE framework with SCT, our study links global insights with local realities. This theoretical integration provides a comprehensive lens to understand the dynamic factors influencing cryptocurrency adoption among entrepreneurial firms in Pakistan. Thus, our study contributes to a more holistic understanding of the interplay between entrepreneurial characteristics, internal and external factors, and the decision-making processes that shape cryptocurrency adoption.

3. Theoretical underpinnings

3.1 Technology-organization-environment (TOE) framework

Numerous researchers and industry experts have employed various theories, models and frameworks to delve into cryptocurrency-related topics. For example, Islam *et al.* (2023) applied the Technology Acceptance Model (TAM) to explore factors influencing cryptocurrency adoption in Bangladesh, while Almajali *et al.* (2022) utilized the extended Theory of Reasoned Action (TRA) model to study intentions to use cryptocurrency in Jordan. While these models provide valuable insights into individual acceptance of innovations, Chen *et al.* (2022) argued that they may oversimplify the complex decision-making processes within organizations regarding cryptocurrency adoption.

Organizational factors such as leadership support and digital resource availability, crucial in cryptocurrency adoption, often need to be adequately addressed by TAM and TRA models (Gunawan and Novendra, 2017). Furthermore, these models overlook external influences such as regulatory frameworks, cultural norms, and economic conditions, significantly impacting cryptocurrency adoption (Taherdoost, 2022). While TAM and TRA are insightful for understanding individual-level adoption (Islam *et al.*, 2023), their application to entrepreneurial firms is limited by their focus on individual perceptions and insufficient consideration of organizational and external environmental factors (Al-Amri *et al.*, 2019).

The TOE framework, introduced by Tornatzky and Fleischer (1990) for organizational technology adoption, offers a more comprehensive approach to studying cryptocurrency adoption in entrepreneurial firms by integrating internal and external perspectives. As further described by Awiagah *et al.* (2016) and Nguyen *et al.* (2022), it provides a robust theoretical foundation for examining innovation adoption across organizational and external levels, incorporating diverse viewpoints.

Existing literature on cryptocurrency adoption explores multiple dimensions impacting the integration of digital currencies in various contexts, emphasizing technological (Nadeem *et al.*, 2021), organizational (Almajali *et al.*, 2022) and environmental factors (Bhimani *et al.*, 2022). Collectively, these dimensions contribute to a comprehensive understanding of the drivers of cryptocurrency adoption, offering valuable insights for businesses, policymakers and researchers.

To fully understand the factors influencing cryptocurrency adoption in entrepreneurial firms, it is essential to expand the TOE framework by incorporating the "innovation

characteristics of entrepreneurs." The decision to adopt cryptocurrencies in entrepreneurial firms is deeply influenced by personal attributes, such as risk tolerance, attitudes toward innovation, and entrepreneurial orientations of business owners and managers (Marcati *et al.*, 2008). These individual-level factors align with SCT, which emphasizes the reciprocal interaction between personal, behavioral and environmental factors in shaping decision-making processes (Neumeyer *et al.*, 2019; Zahra *et al.*, 2023).

The integration of entrepreneurial characteristics into the TOE framework acknowledges that innovation adoption is influenced not only by organizational factors, such as infrastructure and resources (Tornatzky and Fleischer, 1990), but also by the individual's cognitive traits and motivations (Nazir *et al.*, 2022). Factors like openness to new technologies, digital savviness and willingness to take risks are crucial in how entrepreneurs embrace emerging technologies (Abaddi, 2024a). This interaction between individual (entrepreneurial) and organizational (TOE) factors offers a more comprehensive view of innovation adoption, highlighting the role of entrepreneurs as key decision-makers and change agents in the adoption process (Nguyen *et al.*, 2022).

However, previous studies have not extensively explored the "innovation characteristics of entrepreneurs" in the context of cryptocurrency adoption, particularly within Pakistan. Therefore, our research proposes an extended theoretical framework, TOE-Innovation, which introduces a fourth dimension: the innovative characteristics of entrepreneurial firm entrepreneurs. This extension recognizes that owners and managers strongly influence management systems and greatly influence strategic innovation decisions (Taghizadeh *et al.*, 2022), including cryptocurrency adoption to improve financial inclusion and operational efficiency (Sitaridis and Kitsios, 2022). To support this extension, we integrate SCT to align with the study's research objectives and questions.

3.2 Social cognitive theory (SCT)

SCT, formulated by psychologist Albert Bandura, underscores the dynamic interplay between observation, self-efficacy and environmental factors in shaping human behavior (Bandura, 1986). Within organizational innovation adoption, SCT suggests that individuals, such as entrepreneurs, observe and learn from others within their social networks, including businesses that have successfully adopted innovations (Gemmell *et al.*, 2012). They assess the benefits and challenges of these innovations and make adoption decisions based on these observations (Tri Harinie, 2017).

Self-efficacy—the belief in one's capability to perform a specific behavior—is also essential in SCT (Bajaba *et al.*, 2022). As per Santos *et al.* (2010) entrepreneurs with high self-efficacy are more likely to explore and adopt technologies like cryptocurrencies, confident in their skills to understand and implement them effectively within their organizations.

SCT also stresses social and environmental impacts on behavior (Tri Harinie, 2017). Liu and Xi (2022) found that entrepreneurs are influenced by their social networks, industry peers and external stakeholders when deciding on innovation adoption. External factors such as government regulations, market dynamics and technological advancements also play significant roles (Schaupp and Festa, 2018). Thus, SCT explains how entrepreneurs observe, evaluate their self-efficacy and analyze contextual factors affecting innovation adoption, including bitcoin adoption in entrepreneurial firms (Beliaeva *et al.*, 2020; Ince *et al.*, 2023).

3.3 Intersectionality between the TOE-I framework and SCT

Our study integrates the TOE framework with an extended focus on the "innovation characteristics of entrepreneurs" and SCT's three dimensions: observation, self-efficacy, and social and environmental factors—to investigate cryptocurrency adoption in entrepreneurial firms. Focusing exclusively on the intersection of the extended TOE-I dimension and environmental factors with SCT, the study examines how individual entrepreneurial traits interact with environmental influences, emphasizing their critical role.

3.3.1 Observation (SCT) and innovation characteristics of entrepreneurs (TOE-I framework). Entrepreneurs draw on their social networks to observe and assimilate insights into innovation adoption, aligning with the extended TOE-I dimension. Networking and collaboration within peer groups facilitate knowledge exchange and collective decision-making (Marcati *et al.*, 2008), fostering an environment conducive to cryptocurrency adoption within entrepreneurial firms (Li, 2020).

3.3.2 Self-efficacy (SCT) and innovation characteristics of entrepreneurs (TOE-I framework). High self-efficacy among entrepreneurs intersects with the extended TOE-I dimension, fostering openness to explore and integrate innovations like cryptocurrencies. Confident in their digital competencies (Liu and Xi, 2022), entrepreneurs are better positioned to adopt and implement such technologies effectively within their organizations (Taghizadeh *et al.*, 2022).

3.3.3 Social and environmental factors (SCT) and environmental context (TOE-I framework). Social and environmental factors, including social influences, industry dynamics and regulatory frameworks, influence entrepreneurs' decisions regarding innovation adoption (Balconi *et al.*, 2023; Nguyen *et al.*, 2022). These factors correspond to the environmental context of the TOE framework, collectively shaping cryptocurrency adoption within entrepreneurial firms, particularly in underdeveloped countries like Pakistan. By integrating the TOE-I framework with an extended focus on the "innovation characteristics of entrepreneurs," environmental factors, and SCT's three dimensions, our study provides a comprehensive understanding of the factors driving cryptocurrency adoption in entrepreneurial firms, as outlined in the conceptual framework (refer to Figure 1). This integrated approach considers both entrepreneurs' environmental context and individual characteristics, offering insights into the complex dynamics of innovation adoption within entrepreneurial firms.

The adoption of cryptocurrency by entrepreneurial firms is influenced by technological, organizational and environmental factors, as outlined in the TOE framework (Tornatzky and Fleischer, 1990).

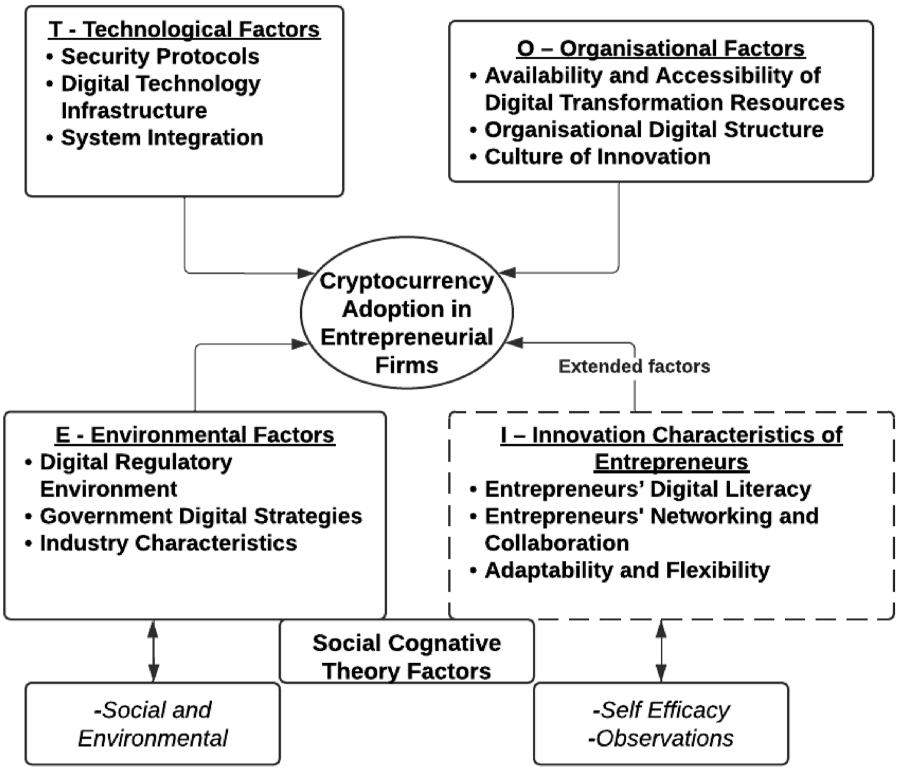
3.4 Technological factors

Three key technological factors impact entrepreneurial firms: security protocols (Nadeem *et al.*, 2021), digital technology infrastructure (Sohaib *et al.*, 2020) and system integration (Nguyen *et al.*, 2022). Security, defined as protecting data and systems from threats, is crucial. For instance, research in China highlights the need for stringent security measures to protect businesses and users from potential losses due to cyberattacks (Nadeem *et al.*, 2021). This concern is especially pertinent for entrepreneurial firms, which may need more robust cybersecurity measures. In Australia, adopting cryptocurrency requires up-to-date digital infrastructure, including compatible point-of-sale (POS) systems and payment gateways (Sohaib *et al.*, 2020). Similarly, research from Vietnam shows that integrating cryptocurrency transactions demands significant technological modifications to ensure compatibility with existing systems like accounting and inventory management (Nguyen *et al.*, 2022).

3.5 Organizational factors

The adoption of cryptocurrency is significantly influenced by organizational factors, including the availability of resources (Al Hadwer *et al.*, 2021). In the UAE, access to digital transformation resources was cited as crucial (Jegerson *et al.*, 2023), while in India, financial resources were mentioned as a pre-requisite for investing in cryptocurrency infrastructure and training (Kumar and Rani, 2024). In Pakistan, skilled personnel were essential for effectively adopting new technologies (Nazir *et al.*, 2024a).

Organizational structure also matters; flexible structures facilitate quicker decision-making and the implementation of cryptocurrency integration (Saiedi *et al.*, 2021). Effective communication within the organization departments ensures all stakeholders are informed



Source(s): Authors' own creation

Figure 1. Intersectionality of extended TOE-innovation and SCT factors – conceptual framework

about adoption plans (Malik *et al.*, 2024). Additionally, in Jordan, Almajali *et al*. (2022) found that a culture prioritizing innovation and risk-taking fosters an environment conducive to adopting new technologies such as cryptocurrencies.

3.6 Environmental factors

Environmental factors include the regulatory environment, government digital strategies and industry characteristics. Bhimani *et al.* (2022) found that clear digital regulations and supportive legal frameworks encourage cryptocurrency adoption by providing security and compliance. The innovation economy in Bangladesh received a significant boost from government programs aimed at digital strategy (Islam *et al.*, 2023). Policies promoting bitcoin adoption, as seen in Indonesia, created a favorable environment for businesses to innovate (Gunawan and Novendra, 2017). The intersection of TOE external factors and SCT suggests that entrepreneurs are more likely to adopt innovations if regulatory and governmental support exists. In Africa, industrial factors profoundly influenced the adoption of Bitcoin, suggesting that industries embracing technology breakthroughs provide a favorable climate for innovation (Koroma *et al.*, 2022).

This study investigates how external factors enable individual Pakistani entrepreneurs to adopt cryptocurrency within their entrepreneurial firms. Cutting-edge technology, internal

organizational challenges and external environmental factors influence cryptocurrency adoption.

The study extends the TOE framework for several reasons:

(1) Many entrepreneurial businesses in Pakistan are managed by individual entrepreneurs with the authority to adopt innovations like cryptocurrency, facing unique operational and environmental challenges (Marcati *et al.*, 2008).

(2) In sole proprietorships or small teams, Li (2020) argued that the decisions of individual entrepreneurs substantially impact the business's adoption of technology, including cryptocurrency.

(3) Entrepreneurs must approve financial investments in technology, like acquiring equipment for cryptocurrency (Taherdoost, 2022), identify opportunities for integration (Abaddi, 2024a) and establish the necessary infrastructure (Saiedi *et al.*, 2021).

(4) Young Pakistani entrepreneurs in entrepreneurial businesses need more financial resources, less access to information and expertise, and a smaller customer base (Nazir *et al.*, 2024a, b). Understanding how they navigate these challenges in cryptocurrency adoption provides valuable insights.

Investigating the "innovation characteristics of entrepreneurs" as an additional element while considering the TOE-I and SCT frameworks' overlapping viewpoints is essential. By leveraging innovation and entrepreneurship, entrepreneurial firms in Pakistan can navigate the complexities of cryptocurrency adoption, capitalizing on its potential financial advantages for their operations and customer base.

3.7 Innovation characteristics of entrepreneurs

Entrepreneurs' digital literacy, adaptability and flexibility, and networking and collaboration are critical for technology adoption. For instance, proficiency in blockchain technology is crucial for enhancing financial performance among Malaysian small business owners (Jalil *et al.*, 2022). In France, entrepreneurial adaptability and flexibility impact technology adoption significantly (Alegre *et al.*, 2013). Entrepreneurs who adapt their business models to integrate new technologies are more inclined to adopt state-of-the-art technologies (Akpan *et al.*, 2022). Networking and collaboration provide insights into peers' experiences with blockchain technology and cryptocurrency adoption (López-Muñoz *et al.*, 2023).

The intersection of the TOE-I and SCT frameworks suggests that entrepreneurs with digital literacy are better positioned to adopt cryptocurrency innovations (Bajaba *et al.*, 2022). Within the TOE-I framework, technological readiness, including infrastructure and security measures, directly impacts adoption, while organizational factors, such as skilled personnel and financial investment, shape firms' capacity to integrate cryptocurrency (Nazir *et al.*, 2022). From an SCT perspective, networking and peer influence enhance social learning, increasing the likelihood of adoption (Li, 2020). Entrepreneurial firms are motivated by cost-effective transactions, operational efficiency and access to decentralized finance (Islam *et al.*, 2023; Nguyen *et al.*, 2022). However, technological barriers, such as inadequate infrastructure and security concerns (Nadeem *et al.*, 2021; Sohaib *et al.*, 2020), organizational constraints, and regulatory uncertainty (Bhimani *et al.*, 2022) hinder adoption. Additionally, innovation traits like adaptability and digital literacy influence adoption, aligning with SCT's emphasis on self-efficacy and environmental factors (Alegre *et al.*, 2013).

The literature indicates that entrepreneurial firms need to consider technological, organizational and environmental factors and entrepreneurs' innovation characteristics when contemplating cryptocurrency adoption. This research highlights the importance of understanding these factors using the TOE-I and SCT frameworks. This will enable Pakistani entrepreneurial firms to make informed decisions and align with internal objectives and the broader financial landscape.

4. Research methodology

This study employed an interpretive qualitative phenomenological approach to explore Pakistani entrepreneurs' perspectives and experiences regarding cryptocurrency adoption in entrepreneurial firms, as suggested by Alase (2017) and Emiliussen *et al.* (2021). As advocated by Frechette *et al.* (2020), the phenomenological methodology is particularly suited for understanding and analyzing individuals' experiences, perceptions and motivations related to cryptocurrency adoption. Semi-structured interviews were conducted with entrepreneurs familiar with technology adoption, utilizing purposive (Campbell *et al.*, 2020) and snowball sampling methods (Creswell and Creswell, 2018). The aim was to achieve a nuanced understanding of factors influencing cryptocurrency adoption, alongside entrepreneurial traits, through in-depth interviews and observations involving entrepreneurs and stakeholders within selected entrepreneurial firms aligned with the research objectives and framework.

4.1 Sampling criteria

To align with the study's objectives and questions, purposive sampling was used to select entrepreneurial firms in Pakistan that have adopted digital innovations or are considering adopting cryptocurrency for financial inclusion. This method was chosen for the reasons provided by Clarke and Braun (2016), as it allows for the intentional selection of participants with relevant experience or insights into the topic. Therefore, we ensured that the sample was directly related to the study's focus on entrepreneurial traits and influencing factors.

Additionally, snowball sampling was employed to identify further participants through referrals from initial participants. This method, advocated by Maharjan *et al.* (2024), helped expand the sample by leveraging the networks of those already involved in cryptocurrency adoption, ensuring a broader representation of perspectives. By using both methods, we could reach a sample that was not only relevant but also diverse, thus enhancing the depth and credibility of the study's findings (Creswell and Creswell, 2018) (refer to Table 2).

The following criteria were used to target entrepreneurs for data collection and interviews (refer to Table 2):

(1) Entrepreneurial firms in Pakistan that are either embracing innovations, including cryptocurrency or considering doing so were selected. As explained earlier in the introduction, the criteria for defining these enterprises were established based on guidelines from government organizations and industry associations such as the Small and Medium Enterprise Development Authority (SMEDA) and the Local and Regional Chambers of Commerce (RCC).

(2) The study focuses on entrepreneurs, managers exhibiting characteristics and traits expected to influence their attitudes and decisions regarding cryptocurrency innovation adoption. These traits were integral to the participant selection criteria, as outlined by Nazir *et al.* (2024b).

(3) Participants needed a certain level of familiarity with innovation, adoption, and technology related to cryptocurrency. This familiarity, either through using it for business purposes within Pakistan or internationally or recognizing its potential impact on their firms, provides valuable perspectives on factors facilitating or hindering cryptocurrency innovation adoption (Koroma *et al.*, 2022).

(4) The adoption of digital innovations, including cryptocurrency, among entrepreneurial firms in Pakistan is still in its early stages, but there is a growing interest, particularly in sectors such as IT and e-commerce. While exact adoption rates still need clarification, studies suggest that many firms are considering or exploring digital technologies to enhance financial inclusion and improve operational efficiency (Nazir *et al.*, 2022, 2024a). Younger entrepreneurs, in particular, are more inclined to adopt fintech solutions, signaling a shift toward embracing blockchain and cryptocurrencies (Malik

Table 2. Participants information

No	Industry	No. of Emp	Firm-year	Resp	Edu	Size-loc	Interviews (F2F/Tele./ Obs.)	Crypto adoption
1	Manufacturing	16	Ceramics Tiles – 2000	Owner and Manager	College and Diploma	Small- Karachi	Face-to-Face, Telephonic	No
2	Services	53	International Logistics Transportation Services – 2001	Owner	Bachelors	Medium-Karachi	Face-to-Face	No
3	Technology	07	Software Development (Local International Clients) – 2016	Owner	Masters	Small-Karachi	Face-to-Face, Observations	No
4	Finance	109	Microfinance – 1999	Owner and Manager	Masters and Finance Diploma	Medium-Karachi	Face-to-Face, Telephonic	No
5	Manufacturing	22	Exporting Plastics PVC and Steel Products – 1997	Owner	Schooling	Small- Lahore	Face-to-Face, Observations	No
6	Services	35	Advertising Public Relations Agency – 2009	Owner and Manager	Certificate and MBA	Small- Lahore	Face-to-Face, Telephonic	No
7	Technology	09	IT Consultancy (Local International Clients) – 2014	Owner	PhD	Small-Lahore	Face-to-Face	No
8	Finance	87	UK Based Insurance – 2017	Owner	ACCA	Medium-Lahore	Face-to-Face, Observations	No
9	Manufacturing	18	Imp and Exp of Cosmetics and Personal Care Products – 2005	Owner	MBA	Small-Islamabad	Face-to-Face	No
10	Services	51	Real Estate Services to Local and International Clients – 2011	Owner	College Diploma	Medium-Islamabad	Face-to-Face	No
11	Technology	11	Data Analytics and Business Intelligence – 2018	Owner and Freelancer-Employee	MSc and University Certificate	Medium-Islamabad	Face-to-Face, Telephonic, Observations	No
12	Finance	39	Money Exchange – 2006	Owner and Broker/ Trader-Employee	Mcom and Kaplan Finance Certificate	Small-Islamabad	Face-to-Face, Observation, Telephonic	No
13	Manufacturing	58	Imp and Exp of Textiles and Garments – 1995	Owner	MBA	Medium-Rawalpindi	Face-to-Face	No

(*continued*)

Table 2. Continued

No	Industry	No. of Emp	Firm-year	Resp	Edu	Size-loc	Interviews (F2F/Tele./ Obs.)	Crypto adoption
14	Services	59	Freelancing – Education and Training Services – 2017	Owner and Freelancer-Employee	PhD and CFA	Medium-Rawalpindi	Face-to-Face, Telephonic	No
15	Technology	60	IT and E-Commerce Outsourcing – 2015	Owner and IT Manager	MSc and IT Degree	Medium-Rawalpindi	Face-to-Face, Telephonic	No
16	Finance	32	Fintech Solutions – 2020	Owner	MBA	Small-Rawalpindi	Face-to-Face, Observations	No
17	Manufacturing	87	Imp and Exp of Leather and Leather Goods – 2003	Owner	Fashion Designing Degree	Medium-Karachi	Face-to-Face	No
18	Services	48	World Tour – Travel Tourism Services – 2013	Owner	Bachelor's Degree	Small- Lahore	Face-to-Face, Observations	No
19	Technology	19	Digital Marketing – 2021	Owner and Marketing Analyst	Masters and BBA	Small-Islamabad	Face-to-Face, Telephonic	No
20	Finance	12	Money Exchange – 2011	Owner	MBA Finance	Small-Rawalpindi	Face-to-Face	No

Source(s): Authors' own creation

et al., 2024). According to (PIAIC) Presidential Initiative for Artificial Intelligence and Computing (2024), the President of Pakistan has launched an initiative to help promote education, research, and business opportunities in Artificial Intelligence, Blockchain and Cloud-based computing. An increase in blockchain trading suggests that interest in financial inclusion through digital technologies is rising; therefore,

(5) The sample for this study included entrepreneurial firms from diverse industries, such as manufacturing, services, technology and finance, to ensure a comprehensive range of perspectives. These sectors are crucial to Pakistan's economy, trade and tax revenues (Nazir *et al.*, 2022). A total of 50 entrepreneurial firms were selected, 30 of which had already adopted digital innovations, and 20 were considering cryptocurrency for financial inclusion. The selection process was conducted in phases: initially, entrepreneurial firms were identified through government bodies like SMEDA and industry associations–RCC. After screening, firms that met digital innovation and cryptocurrency adoption criteria were included.

(6) The sample of entrepreneurial firms in Pakistan was distributed across four key cities—Karachi, Lahore, Islamabad, and Rawalpindi—to ensure a balanced representation from different regions. In Karachi, entrepreneurial firms were selected, comprising three small firms and three medium firms. Lahore contributed six entrepreneurial firms, four small and two medium firms. In Islamabad, five entrepreneurial firms were included, consisting of four small firms and one medium firm. Rawalpindi had three entrepreneurial firms, one small and two medium firms. This distribution ensures the research captures various perspectives on digital innovation and cryptocurrency adoption across diverse business sizes and locations.

(7) For effective data analysis, participants communicated in English and/or Urdu (for transcription). Interviews were held in quiet, distraction-free settings and lasted 45 min to an hour. Nonverbal cues like body language and facial expressions were noted to gauge participants' comfort levels and emotions, particularly regarding sensitive topics like cryptocurrency adoption and financial inclusion.

4.2 Data collection and interview guide—triangulation process

Researchers initiated outreach to entrepreneurial firms in four economic cities of Pakistan based on specified sampling criteria. The data collection comprised the following steps (see Table 3):

4.3 Data analysis

Data collection spanned seven months, with an additional five months allocated for data analysis and report preparation. A qualitative phenomenological approach was employed, utilizing a narrative method to analyze the data and gain insight into participants' lived experiences (Emiliussen *et al.*, 2021; Grossoehme, 2014). Initially, the research team planned to use NVivo (version 14) for data analysis. However, we opted for manual analysis due to the volume of qualitative data and the coding challenges. This approach provided greater flexibility and control in theme identification, aligning better with the study's needs and framework (Maharjan *et al.*, 2024). While NVivo is sound, its graphical limitations do not capture the depth required for this study. Thus, manual coding was more appropriate leading to thematic analysis. Thematic analysis (refer to Table 4) guided the analytical process and was conducted in several stages as described by Clarke and Braun (2016) and Nowell *et al.* (2017).

(1) *Familiarization with Data:* This involved reviewing interview transcripts and immersing researchers in the data to comprehend participants' experiences and perspectives.

Table 3. Data collection and triangulation process

Steps	Description	Details	Outcome
1. Development of Interview Guide	Preparation of interview framework	Developed based on study objectives and the conceptual framework. Includes open-ended questions on themes such as technological, organizational, environmental, and extended factors of innovation characteristics of entrepreneurs	Interview guide was prepared for pilot and formal interviews
2. Formal Interview Process and Purposive Sampling	Execution of formal interviews	Pilot interviews were conducted with 8 entrepreneurial firms (2 firms from each city, selected through random industry size). An additional 8 firms were included, totaling 16 firms for formal interviews. In-person, semi-structured interviews were held with firms' owners, managers, and other stakeholders such as freelancers. Locations and times were arranged in advance, with follow-up visits for further observations	Data collection involved 16 firms (8 pilot + 8 formal interviews)
3. Snowball Sampling and Additional Interviews	Expansion through referrals	An additional 4 firms were identified through snowball sampling, bringing the total to 20 firms. Interviews were conducted in person using the same interview guide	The sample was expanded to 20 firms, ensuring more diverse perspectives
4. Triangulation and Saturation	Validation and confirmation	Data saturation was reached after 20 interviews. An additional 8 telephonic interviews were conducted to fill in missing information. Final transcripts were shared with participants for approval	Data saturation was achieved with 28 interviews (20 in-person + 8 telephonic). Findings were validated through triangulation
5. Observational Data	Direct and indirect observations	Observations included cryptocurrency adoption infrastructure, payment acceptance, and online presence of firms. These were cross-verified with interviews, reports, and financial records	Data reliability and validity were enhanced through observational insights and cross-checking

Source(s): Authors' own creation

(2) *Identifying Patterns and Themes:* Researchers identified patterns and themes in the interview coding transcripts to emphasize essential phrases, similarities, differences, words and concepts related to entrepreneurial characteristics and influential factors affecting cryptocurrency adoption in entrepreneurial firms in Pakistan.

(3) *Generating Themes:* Potential codes from interview phrases were combined to create themes, guided by the coding process and framework to ensure pertinent themes were captured.

Table 4. Thematic matrix

Themes	Sub-themes and codes
Theme 1: technological factors	*Safety and Security Protocols:* KYC protocols, Cyberattacks, Personal ID information, Security verifications, Data breaches, Fraud, Infrastructure upgrades, Bank accounts *Digital Technology Infrastructure:* Digital services, Technology improvements, Foreign payment system, Monitoring system, Scrutiny, Money withdrawals, Nostro accounts, JazzCash and EasyPaisa, Compliance risks *System Integration:* Financial apps, Payment gateways, Digital wallets, Manual recordkeeping, Ongoing maintenance, ATMs, Peer-to-peer transactions, Trust, Letter of Credit
Theme 2: organizational factors	*Access to Digital Transformation Assets:* Financial and Human assets, Educational resources, Bitcoin and Ethereum, Blockchain developers, Cybersecurity experts, Freelancers, Outsourcing *Organizational Frameworks:* Size, Structure, Hierarchy, Centralized and Decentralized hierarchy, IT department, Traditional systems, System malfunctions *Culture of Innovation:* Traditional beliefs, Simple ledgers, Benefits to other entities, Cash dealings, Salaries, Research developments
Theme 3: environmental factors	*Digital Regulatory Frameworks:* Complex regulatory environment, Government policies and backing, Crypto mining, Natural resources, Foreign investment, Hydropower *Roles of National and Local Government Institutions:* Government bodies, Ministry of Finance, State Bank of Pakistan, Financial power and monopoly, Nostro accounts, Anti-money laundering, Formal processes, Compliance *Industry Transition:* Digital payment methods, Artificial money, Digital currency risk, Strict exchange controls, High volatility, Rapid fluctuations, Risky transition, Cryptocurrency exchange companies, Global transactions *Cultural and Religious Beliefs:* Cultural values and religious principles, Shariah law, Haram (forbidden), Religious scholars' fatwas, Cultural interpretations, Misunderstanding of usage, Gambling and prohibition *Social Stigma and Traditions:* Consumer awareness, Traditional barriers, Social beliefs, Preference for cash, Familiarity with cash transactions, ATM machine knowledge
Theme 4: innovation Characteristics of entrepreneurs (extended factors)	*Entrepreneurs' Digital Literacy:* Social media resources (YouTube), Cryptocurrency wallets, Digital literacy in young employees, Fintech technology, EasyPaisa and JazzCash literacy *Entreprenuers' Strategic Networking and Collaboration:* Business growth, Knowledge sharing, IT and Fintech opportunities, IT events and conferences, Blockchain access, Blockchain consortiums *Adaptability and Flexibility:* Volatility and risk, Financial efficiency, Reduce transaction costs, Risk management, Misconceptions, Traditional mindset, Risk-free transactions (e.g. bank drafts and cash) *Senior Management (older employees) Education and Training:* Risk aversion, Outdated education, Lack of understanding, Resistance to change, Fear of job loss, Time-consuming, System integration, Training and support, Reliance on young IT staff

Source(s): Authors' own creation

(4) *Refining Themes and Sub-Themes:* Themes were examined, and additional sub-themes arose from patterns such as narratives, expressions, and documented participant stories, as well as researchers' observations, identified through engaged reading and abstractions (Hammersley, 2015).

(5) *Naming and Defining Themes:* Final themes and sub-themes were defined and named, ensuring four pertinent themes (Technological, Organizational, Environmental and Innovation characteristics of entrepreneurs) were captured, along with relevant and emerging new sub-themes.

(6) *Organizing Data into Thematic Clusters:* Data was sorted into thematic clusters (thematic matrix) after identifying essential patterns and themes. This involved creating tables to organize data using themes, sub-themes and codes based on the framework, specific entrepreneurial traits and influential factors affecting cryptocurrency adoption in entrepreneurial firms in Pakistan (refer to Table 4).

(7) *Developing Descriptions and Interpretations:* Detailed descriptions and interpretations of the findings were developed, integrating quotes and examples from interviews to illustrate study objectives and questions (Saunders *et al.*, 2018).

(8) *Validation:* The findings were validated by presenting the analysis to experts in entrepreneurship and innovation in Pakistan, Saudi Arabia and the UK This ensured accurate interpretations and meaningful insights (Nazir *et al.*, 2024b).

Ethical treatment of participants was paramount, encompassing informed consent, confidentiality and safeguarding well-being and dignity (Nowell *et al.*, 2017). Addressing power dynamics and ensuring a comfortable environment for sharing were critical. Transparency regarding researchers' intentions and potential biases upheld study integrity (Nazir *et al.*, 2024b). Trustworthiness was enhanced through member checking and trustworthiness criteria, ensuring credible, transferable, dependable and confirmable findings (Ozuem *et al.*, 2022).

The narrative phenomenological analysis offers deep insights into individual experiences, which is crucial for understanding cryptocurrency adoption in Pakistan's entrepreneurial firms.

5. Findings

The study's findings are organized around four main themes: technological, organizational, environmental and innovation characteristics of entrepreneurs, each with corresponding sub-themes. These themes, derived from narrative data analysis, highlight the challenges and enablers of cryptocurrency adoption among entrepreneurial firms in Pakistan.

5.1 Technological factors – theme 1

Technological factors significantly influence the adoption of cryptocurrency by entrepreneurial firms in Pakistan, particularly regarding *safety and security protocols*, *digital technology infrastructure* and *system integration*.

5.1.1 Safety and security protocols. One key concern entrepreneurs raise is the safety of cryptocurrency transactions, especially with Know Your Customer (KYC) protocols. Entrepreneurs emphasized the need for robust KYC processes to prevent data breaches and fraud. They highlighted that while KYC verification ensures security, it raises concerns about privacy and handling sensitive customer data. As an IT entrepreneur noted:

> Our priority should be security measures directly linked with KYC. For example, in our business when dealing with international clients, we must share our business IDs as per government law. In crypto, any exchange operating in Pakistan or globally will require your information, including an ID card and a selfie, for account verification. This prevents black market activities and scams in the crypto world. - *IT Consultancy, Owner*

Entrepreneurs also pointed out the role of the Pakistani government in improving digital infrastructure and integrating KYC technology to protect customer data. However, they acknowledged the risks of implementing KYC while emphasizing its necessity. As respondents explained:

> Recent incidents in Pakistan highlight the need for the government to improve infrastructure and implement KYC crypto technology to protect customer data from cyber threats. However, adopting KYC protocols and addressing data security concerns involve some risks. - *Microfinance, Owner and Manager*

5.1.2 Digital technology infrastructure. A major challenge identified was the disparity in digital infrastructure between urban and rural areas. Despite some improvements in government services, the infrastructure still needs to be improved to support blockchain technology fully. Entrepreneurs noted that while blockchain could lower transaction fees and increase speed, current systems limit cryptocurrency adoption, particularly for domestic transactions. Both respondents stated:

> The State Bank of Pakistan (SBP) requires transactions involving foreign funds to pass through a Nostro account, ensuring transparency and traceability. However, the current system does not support cryptocurrency technology.- Ceramics Tiles, Owner and Manager

In addition to infrastructure issues, entrepreneurs highlighted fraud prevention and regulatory compliance concerns. They noted that inadequate systems increase vulnerabilities to data breaches and legal penalties. A business owner emphasized these risks:

> As a small business owner, I face challenges in recording transactions and complying with anti-money laundering regulations due to insufficient tools for managing digital currency transactions securely. This could lead to penalties and legal issues for our business. - Money Exchange, Owner

5.1.3 System integration. The integration of cryptocurrency into existing systems remains complex, requiring advances in technology and regulation. Entrepreneurs stressed the need for stable financial apps and digital wallets. However, despite technological progress, the infrastructure still needs to improve, hindering blockchain adoption. One entrepreneur in the financial sector observed:

> Despite advancements, there are back-end issues with ATMs (Automated Teller Machines), indicating a technological lag. Blockchain technologies require further progress. - *Fintech Solutions, Owner*

Trust in the financial system is another key issue for cryptocurrency adoption. Unlike traditional financial methods, which use intermediaries like Letters of Credit (LC), cryptocurrency transactions rely on decentralized blockchain technology. This creates risks, particularly in peer-to-peer transactions. As one entrepreneur put it:

> Current fund transfer methods within Pakistan, like JazzCash, are limited to domestic transactions. In contrast, crypto operates globally, affecting both local and international aspects. - *Real Estate Services, Owner*

5.2 Organizational factors – theme 2

Internal organizational factors, such as *access to digital transformation assets*, *organizational frameworks* and *a culture of innovation*, also significantly impact cryptocurrency adoption.

5.2.1 Access to digital transformation assets. Entrepreneurs emphasized the need for experienced human resources and financial backing to ease the integration of cryptocurrencies into their businesses. Many business owners expressed concerns over a lack of these critical assets, which hindered the adoption process. A financial industry entrepreneur stated:

> When it comes to cryptocurrencies like Bitcoin and Ethereum, securing sufficient financial backing is essential. This involves not only investing in digital assets but also covering expenses related to regulatory compliance, security measures, and technological infrastructure. - *Fintech Solutions, Owner*

In addition to financial resources, a shortage of skilled personnel in blockchain, cryptocurrency trading and regulatory compliance emerged as a significant challenge. Entrepreneurs emphasized the need for blockchain developers, cybersecurity experts and legal advisors. Many advocated for national surveys to identify talented individuals (freelancers) who are underutilized due to government restrictions. One entrepreneur shared:

> In my company, I work with clients from the UK (United Kingdom) and USA (United States of America). Sometimes, when short-staffed, we hire freelancers to help our international clients. Pakistan has a strong community of young freelancers who work remotely on an hourly basis. I often use their services to meet the needs of my overseas clients, and they consistently deliver. Given their skills and availability, why not hire them permanently for cryptocurrency projects? I trust their abilities, especially in providing blockchain training to entrepreneurs. Currently, we lack cryptocurrency expertise in-house, whereas freelancers excel in this field. - *IT Consultancy, Owner*

5.2.2 Organizational frameworks. This sub-theme also plays a critical role in the adoption of cryptocurrency. Entrepreneurs emphasized the need for well-defined structures, particularly in IT support and decision-making. The lack of clear roles and responsibilities often hinders progress. Both entrepreneurs highlighted:

> Our organisational structure lacks a well-equipped and dedicated IT department, resulting in delays in resolving even minor technical issues. This underscores the inadequacies of our current setup to support advanced technologies such as cryptocurrencies – *Advertising Public Relations Agency, Owner and Manager*

Entrepreneurs also argued that a strong organizational framework is necessary for efficient cryptocurrency transactions across various sectors. However, inefficiencies in internal structures and external banking systems often hinder adoption. As entrepreneurs noted:

> In banks, centralized IT departments frequently cause operational halts at branch levels during IT issues, exposing systemic flaws. Power outages exacerbate these challenges for traditional banking systems adapting to digital transactions. – *Money Exchange, Owner and Broker/Trader-Employee*

Entrepreneurs in the finance sector also pointed out:

> ATM operations reveal slow response times to technical issues within organisational frameworks. This highlights the need for decentralized, agile structures capable of managing cryptocurrency transaction demands effectively. – *Microfinance, Owner and Manager*

5.2.3 Culture of innovation. Entrepreneurs also noted that a culture of innovation is essential for cryptocurrency adoption. However, many firms resist change, preferring traditional cash transactions and simple ledgers. This reluctance to adopt new technologies impedes growth. One entrepreneur remarked:

> In our cash-based society, firms rely on cash transactions and simple ledgers despite high turnovers (up to Pak Rs 1 million [approx. US $ 3,600]). They see tech advancements as unnecessary, preferring proven methods. - *Exporting Plastics, Owner*

Financial innovation is seen as a key factor in driving cryptocurrency adoption. Entrepreneurs emphasized the importance of a research-focused approach and collaboration to assess and implement blockchain projects. A lack of competitive compensation also limits the ability to attract top talent. As IT entrepreneurs explained:

> Investing in a research team assessing projects, roadmaps, and achievements is critical. Collaborative efforts and thorough research drive financial decisions. Low salaries hinder new digital innovation. - *Digital Marketing, Owner and Marketing Analyst*

This statement underscores the importance of strategic evaluation of blockchain projects and the need for competitive compensation to attract talent, which is essential for fostering creativity and resilience in a rapidly changing industry.

5.3 Environmental factors – theme 3

Digital regulatory frameworks, the role of national and local government institutions, industry transition, and *cultural and religious barriers*, including *social stigma and traditions*, significantly influence cryptocurrency adoption among entrepreneurial firms in Pakistan. These emerging factors shape firms' willingness to adopt cryptocurrency technologies.

5.3.1 Digital regulatory frameworks. Pakistan's regulatory frameworks and government policies are crucial in facilitating or hindering cryptocurrency adoption. Entrepreneurs often express concerns about the ambiguous regulatory environment and the lack of explicit government policies on cryptocurrency, which poses challenges for potential investments. One participant mentioned:

> The regulatory environment lacks the confidence needed for us to consider investing in cryptocurrency. - *UK Based Insurance, Owner*

Entrepreneurs across industries assert reservations. For instance, mining tokens, which consume significant electricity, are impacted by regulatory environments. An IT firm owner noted:

> Pakistan, with its natural resources, could attract foreign investments. Figures like Wakar Zaka utilize hydropower for mining, showcasing a cost-effective approach. Government efforts to reduce barriers and promote foreign investments could position Pakistan as a mining hub akin to China. However, integrating these investments with existing regulatory frameworks, technological infrastructure, and security measures requires careful consideration. *Data Analytics and Business Intelligence, Owner and Freelancer*

5.3.2 Role of national and local government institutions. National and local governmental institutions play crucial roles. Centralized financial oversight, primarily under the SBP, oversees external remittances, currency dealings, and financial transactions. The Ministry of Finance also plays a role. An entrepreneur from the financial sector illustrated how this oversight affects cryptocurrency adoption:

> Funds entering Pakistan through Nostro accounts undergo rigorous anti-money laundering checks. In crypto, where there's no physical money, entrepreneurial firms would struggle with this centralized financial authority. – *Money Exchange, Owner*

Another entrepreneur from the manufacturing sector emphasized procedural complexities and regulatory scrutiny involved in international cryptocurrency transactions:

> If someone sends me crypto, and I inform the State Bank, their immediate concern would be the sender and recipient. It is new territory for them, deterring us from navigating such convoluted regulatory frameworks. - *Cosmetic Products Import and Export, Owner*

5.3.3 Industry transitions. Transitioning to the cryptocurrency industry presents challenges for firms in Pakistan due to the industry's unique characteristics. There's skepticism about Pakistani industries' readiness to adopt cryptocurrency, particularly as a payment method. The lack of proper government backing and regulatory frameworks contributes to the general public's and businesses' mistrust in digital currencies. Many entrepreneurs perceive digital currency as "artificial" money lacking tangible value unless physically possessed. The prevailing preference for cash transactions reflects uncertainty about regulatory frameworks. Even if cryptocurrencies were widely implemented, convincing industry stakeholders of their practical value as a payment method remains challenging. Effective digital regulations could potentially bridge this gap, as mentioned by entrepreneurs:

> We operate in the IT sector, dealing mainly in US dollars with clients from the US (United States) and UAE (United Arab Emirates), occasionally facing hesitation due to strict exchange controls. We encounter difficulties with regular transactions even now. So, why should we view cryptocurrency differently? Despite its potential for widespread adoption, convincing the industry of its practical payment value remains challenging. Clear digital regulations can help bridge this gap. *IT and E-commerce outsourcing, Owner and IT Manager*

An entrepreneur from the finance industry argued that cryptocurrency markets are highly volatile, with prices subject to rapid fluctuations. This volatility risks businesses accepting or holding cryptocurrencies as assets, impacting revenue and financial stability. He cited his client in Dubai:

> Dubai is open to cryptocurrency and blockchain technology, with exchange companies converting coins into cash and government regulation supporting these innovations. However, in Pakistan, transactions between industry clients in different countries (Pakistan and UAE) are complicated by our insufficient regulatory system. - *Fintech Solutions, Owner*

5.3.4 Cultural and religious beliefs. Our study also identifies the impact of cultural and religious beliefs on cryptocurrency perceptions in Pakistan. Certain stakeholders view cryptocurrency as misaligned with local values or religious beliefs, which may impede adoption. Entrepreneurs emphasized the importance of addressing these external factors to foster cryptocurrency adoption. Religious beliefs significantly shape views on the legality and legitimacy of cryptocurrency, as some refer to religious rulings (fatwas) that deem cryptocurrencies such as Bitcoin forbidden (haram), creating an obstacle to widespread adoption:

> Prominent religious scholars have issued fatwas, settling the debate within our community. A recent fatwa from a well-known Mufti, with substantial followership in Pakistan, has had a significant impact. – *Imp and Exp of Leather and Leather Goods, Owner*

Another IT entrepreneur discussed how religious considerations posed a significant challenge to cryptocurrency adoption in Pakistani culture, deeply influenced by Islamic principles:

> The concept of "haram" applies to spot and futures markets. Misconceptions arise due to inadequate understanding. Scholars often declare it "haram" without fully grasping its workings. Consider El Salvador, where cryptocurrency fights inflation, with transactions faster and cheaper than traditional banks, which is ideal for international transactions. Personally, I don't understand why it's labelled "haram" in our culture. – *IT and E-commerce Outsourcing, Owner and IT Manager*

5.3.5 Social stigma and traditions. This sub-theme further hinders technology awareness and cryptocurrency understanding among firms in Pakistan. Entrepreneurs cited entrenched resistance to change and unfamiliarity with digital transformations as significant obstacles. The everyday use of cash transactions highlights a reluctance to embrace cryptocurrency technologies, as many individuals favor traditional monetary practices:

> Recipients of the Benazir Income Support Program, receiving substantial funds, are given ATM cards but often lack the knowledge to use them, relying on others for cash withdrawals. – *Microfinance, Owner and Manager*

Reflecting on these challenges, IT entrepreneurs stressed the need for increased awareness and regulatory clarity to facilitate cryptocurrency adoption in Pakistan:

> ATMs primarily display instructions in English, with some incorporating Urdu. Despite this, many people struggle to understand them, particularly from lower-income backgrounds. Even with Urdu instructions, navigating ATM screens remains challenging. – *Freelancing Education and Training, Owner and Freelancer*

SCT underscores the impact of social influences, industry dynamics and governmental regulations on motivating entrepreneurs to adopt innovations. Our study illustrates that external factors, such as traditional social stigma, religious-cultural barriers, industry transitions and regulatory environments, significantly shape cryptocurrency adoption. In the

context of Pakistani society, these external elements create substantial obstacles, impeding individual entrepreneurs from embracing blockchain innovations and hindering their transition to more advanced technological solutions.

5.4 Innovative characteristics of entrepreneurs (extended factors) – theme 4

Various entrepreneurial innovation characteristics heavily influence cryptocurrency adoption among entrepreneurial firms in Pakistan. These include *entrepreneurs' digital literacy, strategic networking and collaboration*, *adaptability and flexibility*, and *education and training for senior managers* on innovative tools. These factors are crucial for firms' readiness to embrace cryptocurrency.

5.4.1 Entrepreneurs digital literacy. Digital literacy refers to the proficiency of entrepreneurial managers in using digital technologies, such as operating computers and smartphones, navigating online platforms, and understanding digital tools related to cryptocurrency.

One entrepreneur from the hospitality industry narrated:

> Digital literacy was not an issue in their firm, as most employees were young and familiar with new technologies, often learning from free resources like YouTube. - *World Tour, Owner*

Another finance sector entrepreneur echoed this sentiment:

> Digital literacy isn't challenging; understanding crypto is easily accessible through various YouTube tutorials, covering basics to advanced levels. My role involves day trading, planning trades at specific times, and considering profit and loss targets. Currently, I refrain from investments; however, Bitcoin halving, a distinct field, is relevant to future investment planning based on projects. Regarding literacy, it's easily acquired via YouTube." – *Fintech Solutions, Owner*

Entrepreneurs across different sectors indicated that most possess sufficient digital literacy to grasp cryptocurrency, mainly if legally established and backed by regulatory frameworks. They highlighted their familiarity with FinTech technologies, indicating readiness to adapt to new digital innovations. One entrepreneur compared digital FinTech literacy to using platforms like JazzCash and EasyPaisa in her firm:

> Just as we use JazzCash and EasyPaisa daily, appreciating their convenience and endorsement by the State Bank, we trust their reliability. If cryptocurrency is officially approved, we expect similar benefits, allowing us to handle payments, utility bills, and finances smoothly. With legal approval, we would readily adopt cryptocurrency, ensuring its legitimacy and our financial security. – *Import and Export of Textile and Garments, Owner*

5.4.2 Strategic networking and collaboration. Strategic networking and collaboration boost engagement with industries lacking digital literacy and leverage emerging technologies like blockchain. These efforts include connecting with blockchain startup entrepreneurs, attending industry events and sharing knowledge to tackle innovation challenges. Active networking offers significant advantages for Pakistani entrepreneurs, particularly the youth, in grasping cryptocurrency trends, exchanging experiences and pursuing partnerships for crypto initiatives.

An IT entrepreneur illustrated how networking played a crucial role in launching a freelancing FinTech startup and venturing into crypto technology:

> As the youngest IT entrepreneur in Islamabad, I attended a 2021 young entrepreneurs' conference hosted by the Islamabad Chamber of Commerce while studying at a local university – NUST (National University of Sciences and Technology), which has an incubation centre. There, I met successful AI (Artificial Intelligence) and FinTech business owners. Joining FinTech-focused networking groups as a small business owner allowed me to attend events nationwide and learn from experienced entrepreneurs." - *Fintech Solutions, Owner*

A technology entrepreneur shared his experience attending a blockchain conference in Karachi:

> I attended a blockchain conference in Karachi, where I met representatives from cryptocurrency exchanges, regulatory authorities, and other entrepreneurial firms interested in blockchain technology. Through networking, I discovered opportunities for leveraging blockchain and formed valuable connections with potential partners, transforming my business and attracting more clients. – *Data Analytics and Business Intelligence, Owner*

A manufacturing sector entrepreneur highlighted how knowledge sharing and collaboration enhanced understanding of new technologies and proved vital for business innovation:

> In Lahore, a group of entrepreneurial firm owners, including myself, formed a blockchain consortium called "The Knowledge Academy" to share knowledge and resources related to cryptocurrency adoption. Consortium members collaborate on projects leveraging blockchain to improve business operations and drive innovation. With this consortium, I have implemented FinTech in my firm. While our focus is currently on FinTech applications, such collaborations lay the groundwork for further technology adoption, such as cryptocurrency. - *Exporting Plastics PVC and Steel Products, Owner*

5.4.3 Entrepreneurs adaptability and flexibility. Entrepreneurs in Pakistan have gained insights into blockchain and fintech through collaboration and networking. However, they hesitate to embrace cryptocurrency due to concerns about volatility and risks, complicating their adaptability and flexibility. This highlights the importance of their willingness and ability to adopt new technologies to enhance their businesses. For example, a business owner in the service industry, recognizing cryptocurrency's potential to reduce transaction costs, demonstrates adaptability by integrating it into their payment systems. However, entrepreneurs from other firms within the same industry showed limited interest in blockchain technology due to perceived business risks. One stated:

> Adaptability and risk tolerance are crucial. Crypto's appeal lies in its volatility, like stocks and forex. Proper risk management can help businesses navigate crypto as a standard investment. – *World Tour Travel and Tourism, Owner*

Another entrepreneur echoed:

> The challenge comes from a reluctance to take risks in our industry. People prefer familiar methods, like cash and bank drafts, seeing them as safest. – *International Logistics and Transportation Services, Owner*

5.4.4 Education and training for senior managers (older employees). Education and training support for senior managers are vital for transitioning to blockchain technologies. Data indicate senior managers play crucial roles in decision-making and strategy. Many seasoned managers and employees hesitate to embrace cryptocurrency, showing outdated education and a lack of understanding of blockchain technologies, making them more risk-averse. As one manager shared:

> I joined this firm in 2011 with a basic business education. My younger boss implemented FinTech in 2017. It took me 7 months to understand it. Near retirement, learning blockchain technology seems unfeasible. – *Advertising Public Relations Agency, Manager*

Another manager from the service industry stated:

> Our business is slowly adopting new methods, but many senior managers resist new technologies. My role involves basic computer use for Western Union transactions. I struggle with troubleshooting and don't understand blockchain, making training essential." – *Freelancing Education and Training Services, Freelancer*

Senior managers generally show less willingness to take risks with new technologies like cryptocurrency. One illustrated:

> Young IT colleagues work on the latest tools while I handle customer complaints. Adopting blockchain technology seems risky, and I fear job loss. - *Real Estate Services to Local and International Clients, Owner*

Business owners acknowledge these challenges, another narrated:

> Senior managers from the 2000s lack understanding of new technologies. Transforming to FinTech required extensive training and support. While some adapted, older employees often need IT help, and ongoing training is impractical. Older employees fear job loss, impacting their adoption of new systems. – *Ceramic Tiles, Owner*

Another entrepreneur added:

> In manufacturing, long-serving employees are loyal but resistant to technology. One in quality assurance excels at physical inspections but struggles with digital systems. Training in blockchain seems futile if employees are apprehensive about technology, affecting productivity. - *Leather and Leather Goods, Owner*

Entrepreneurs' self-efficacy and digital skills drive innovation within the TOE-I framework. In Pakistan, cryptocurrency adoption hinges on entrepreneurs' confidence and ability to learn via digital platforms. Those with high self-efficacy leverage social media to adopt and implement new technologies, fostering cryptocurrency acceptance. Strategic networking and collaboration at events facilitate idea exchange, aiding young entrepreneurs' transition to FinTech and cryptocurrencies. However, due to outdated education and fear of job loss, senior managers' resistance to technology obstructs cryptocurrency innovation in entrepreneurial firms in Pakistan.

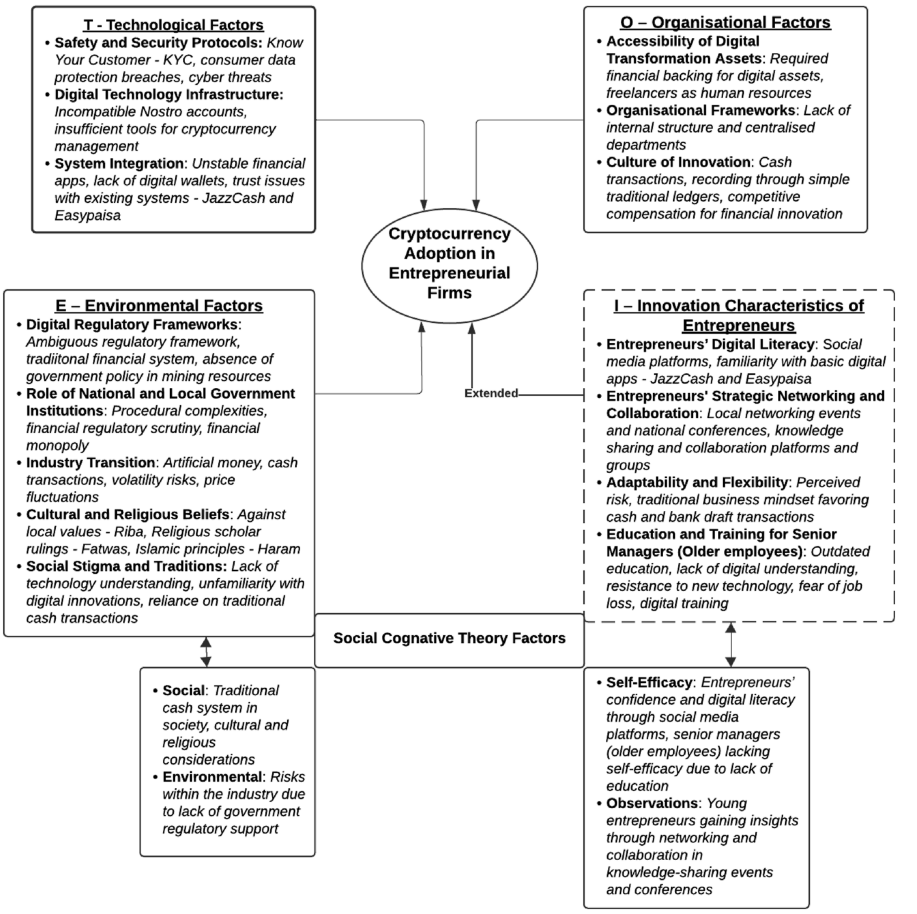
6. Discussion

This study, grounded in an intersectional framework, identifies critical barriers to cryptocurrency adoption among entrepreneurial firms in Pakistan. The findings highlight several key challenges within four primary themes reflecting broader issues. A new proposed framework (see Figure 2) further explores these challenges.

Technological factors were identified as a significant obstacle, particularly regarding *safety and security protocols, digital technology infrastructure and system integration challenges*. Entrepreneurs expressed concerns about the security of cryptocurrency transactions, particularly the vulnerabilities associated with KYC protocols and cybersecurity risks, consistent with concerns raised by Nadeem *et al.* (2021) and Albayati *et al.* (2020). To mitigate these challenges, entrepreneurial firms must invest in robust digital security systems. However, the lack of a supportive regulatory framework for cryptocurrencies, including the absence of cryptocurrency Nostro accounts and integration with the State Bank's systems, severely limits the ability of firms to adopt digital currencies effectively.

Moreover, integrating digital technologies like cryptocurrencies into existing business frameworks remains a significant barrier. Prior studies have emphasized the need for seamless integration of new technologies with traditional systems (Sohaib *et al.*, 2020; Ali *et al.*, 2020). Our findings corroborate this, showing that technologies such as digital wallets and efficient payment gateways are necessary but often lacking. Despite the widespread use of platforms like JazzCash and EasyPaisa for mobile transactions, these are currently unable and trustworthy to support cryptocurrency transactions, highlighting a significant infrastructure gap. Similarly, while ATMs remain the most common method for cash transactions, they are not designed to handle cryptocurrency exchanges or facilitate international transfers, further limiting access to crypto-related services. Addressing these technological barriers through investment in infrastructure and the development of regulatory frameworks is critical to fostering the adoption of cryptocurrency (Bhimani *et al.*, 2022; Nguyen *et al.*, 2022; Taherdoost, 2022) and supporting innovation in Pakistan's entrepreneurial sector.

The adoption or rejection of cryptocurrencies in Pakistani entrepreneurial firms is deeply shaped by *organizational factors*, which present significant internal challenges. This study identifies three crucial sub-themes: the *availability and accessibility of digital transformation assets, organizational frameworks and the culture of innovation*.



Source(s): Authors' own creation

Figure 2. TOE-Innovation and SCT factors – proposed new conceptual framework for the adoption of cryptocurrency in entrepreneurial firms

First, the need for sufficient financial resources, as highlighted in the Indian context (Kumar and Rani, 2024), is also crucial for Pakistani entrepreneurs. Entrepreneurs face significant expenses related to regulatory compliance, cybersecurity and the development of technological infrastructure necessary for cryptocurrency adoption. These costs reflect the broader challenge of securing adequate financial backing to invest in the resources required for effective innovation (Al Hadwer *et al.*, 2021; Jegerson *et al.*, 2023).

The availability of skilled human resources for innovation adoption is another critical factor. As demonstrated by Al Reshaid *et al.* (2024) in Turkey and El Chaarani *et al.* (2024) in France, having access to trained personnel is vital for integrating emerging technologies like blockchain into business operations. In Pakistan, the use of freelancers to address staffing gaps in cryptocurrency-related ventures highlights the importance of specialized knowledge and training programs to support technology integration.

Furthermore, access to educational resources and workshops is essential for enhancing entrepreneurs' understanding of cryptocurrency markets, technology and regulatory

frameworks. Our findings underscore the need for educational initiatives to improve operational knowledge and compliance with cryptocurrency regulations.

Pakistani entrepreneurial firms, especially smaller ones, encounter considerable obstacles in adopting cryptocurrencies. Insufficient IT budgets and the lack of skilled IT professionals hinder their capability to manage digital currency transactions. Moreover, the dependence on traditional banking systems with centralized IT structures leads to operational delays during technical issues, underscoring systemic barriers to cryptocurrency integration. Adopting decentralized and agile systems, as exemplified by countries like China (Huang, 2019) and the Australia (Sohaib *et al.*, 2020), could address these challenges and enable smoother adoption of crypto-related technologies.

The absence of an organizational culture of innovation significantly hinders cryptocurrency adoption in Pakistan. In contrast to businesses in more progressive cultures, such as Jordan (Almajali *et al.*, 2022) and Spain (Arias-Oliva *et al.*, 2019), Pakistani entrepreneurial firms tend to adopt a risk-averse mindset, favoring traditional cash transactions over digital currencies. This conservative approach, combined with the reliance on manual, paper-based ledgers and basic cash-based accounting systems, slows digital transformation and creates challenges in adopting sophisticated, automated financial systems necessary for cryptocurrency integration. Overcoming this resistance requires substantial investment in technology and targeted compensation strategies to motivate staff to transition from traditional to digital financial innovations, fostering a culture conducive to blockchain adoption.

The adoption of cryptocurrency among entrepreneurial firms in Pakistan is influenced by a range of external *environmental factors*, including *digital regulatory frameworks*, *national and local government institutions*, *industry transitions*, *cultural and religious beliefs*, and *social stigma and local traditions*. These factors either facilitate or hinder the widespread use of cryptocurrency technologies among Pakistani entrepreneurs.

A major barrier to cryptocurrency adoption in Pakistan is the underdeveloped regulatory framework. Entrepreneurs frequently express concerns about the lack of clear legal guidelines and the ambiguity surrounding the status of cryptocurrencies. This uncertainty discourages potential investors and stifles innovation. Without a well-defined legal framework, many businesses hesitate to engage with cryptocurrencies, limiting their adoption. The absence of a regulatory body dedicated to digital assets exacerbates this problem. In contrast, countries like the Indonesia and UAE have government-backed initiatives that support the growth of the digital economy (Gunawan and Novendra, 2017; Jegerson *et al.*, 2024), while Pakistan's regulatory environment remains inadequate. Clear and consistent regulations are essential to building trust and fostering investment, as seen in multiple markets (Albayati *et al.*, 2020; Bhimani *et al.*, 2022).

Pakistan's regulatory framework primarily emphasizes traditional financial systems, such as monitoring remittances and currency exchanges through institutions like the SBP and the Ministry of Finance. This focus has led to a regulatory gap, hindering the development of industries such as cryptocurrency mining, which could leverage Pakistan's natural resources. Entrepreneurs have noted that the government's prioritization of physical assets exacerbates challenges in accommodating the cryptocurrency sector's needs. Adopting a more inclusive regulatory approach could foster the growth of cryptocurrency-related industries, as observed in similar studies conducted in Bangladesh (Islam *et al.*, 2023) and in Malaysia (Chen *et al.*, 2022).

National and local government institutions significantly influence the cryptocurrency ecosystem. Centralized financial oversight by the SBP and the Ministry of Finance, while crucial for maintaining financial stability, imposes procedural complexities that hinder cryptocurrency adoption. The rigid control inherent in traditional financial systems clashes with the decentralized nature of cryptocurrencies, creating barriers for cross-border transactions. Additionally, stringent anti-money laundering (AML) checks, reporting requirements and financial regulatory scrutiny place an undue burden on entrepreneurs, especially those engaging with international clients. This financial monopoly over regulatory

frameworks not only restricts innovation but also limits the flexibility required to adapt to emerging technologies. To foster growth, studies by Koroma *et al.* (2022), Li (2020), and Nguyen *et al.* (2022) insisted that a more adaptable and inclusive regulatory approach is essential for digital technology adoption.

Industry transition characteristics play a crucial role in cryptocurrency adoption. Sectors such as IT and e-commerce, which frequently interact with international clients, are more accustomed to using digital currencies. In contrast, other industries remain hesitant, largely due to the absence of government support and a persistent reliance on traditional cash transactions. Concerns about cryptocurrency market volatility and perceptions of digital currencies as "artificial money" further deter adoption. As highlighted by Arias-Oliva *et al.* (2019), Huang (2019) and Nazir *et al.* (2024a), industry readiness is pivotal for widespread adoption. To advance, Pakistan's industries must address these doubts and foster a more open attitude toward digital financial tools.

The volatility of cryptocurrency markets further hampers adoption. Entrepreneurs, especially those in small industries, rely on stable cash flows and are hesitant to adopt cryptocurrencies due to their price instability. This volatility, combined with the lack of regulatory oversight, makes cryptocurrencies a risky business option. To address these concerns, Pakistan needs to implement clear digital regulations that tackle issues of volatility, payment stability and security. Such regulations would help shift the perception of cryptocurrencies from speculative assets to reliable business tools. Drawing from countries like Malaysia, which have promoted digital innovation through proactive regulatory frameworks (Al-Amri *et al.*, 2019), Pakistan could create a more conducive environment for cryptocurrency adoption.

Cultural and religious beliefs also influence cryptocurrency adoption. Religious scholars in Pakistan have issued fatwas declaring cryptocurrencies like Bitcoin as "haram" (forbidden), creating resistance among conservative segments. This stems from concerns over cryptocurrencies' compatibility with Islamic principles, such as "Riba" (interest) and their perceived lack of tangible value. These religious rulings have led to misconceptions about cryptocurrencies. Entrepreneurs report that many people, especially in conservative communities, view cryptocurrencies as risky investments. However, as seen in countries like El Salvador, where cryptocurrency has been embraced to address economic challenges, a shift in perception is possible through more informed discussions.

Social stigma is another barrier to cryptocurrency adoption. Many people, particularly from lower-income backgrounds, are unfamiliar with digital financial tools and prefer traditional cash transactions. This preference for physical money reflects a broader reluctance to embrace technological change. According to SCT, cultural norms and social influences shape entrepreneurial decisions to adopt new technologies (Liu and Xi, 2022; Tri Harinie, 2017). In Pakistan, these social influences are largely negative, with a strong attachment to cash-based systems. Increasing public awareness and financial literacy about cryptocurrencies is essential to reducing stigma and encouraging broader adoption, as seen as an implication in other economies too (Balconi *et al.*, 2023; Nguyen *et al.*, 2022).

Our study's extended theme focuses on the *innovative characteristics of entrepreneurs* and how they influence cryptocurrency adoption among entrepreneurial firms in Pakistan. Key factors include *entrepreneurs' digital literacy, strategic networking and collaboration, adaptability and flexibility,* and the need for *education and training of senior (older) employees*, emerging as sub-themes. These elements are examined within the TOE-I framework and SCT, offering insights into how entrepreneurs' readiness to embrace digital innovations like cryptocurrency is shaped.

A significant factor identified is digital literacy. Many entrepreneurs, particularly in IT, e-commerce and fintech, do not view digital literacy as a barrier. Their familiarity with digital tools makes it easier to adopt new technologies like cryptocurrency. Entrepreneurs across industries noted using accessible online resources, through social media platforms like YouTube, to learn about cryptocurrency. This supports existing research that emphasizes

entrepreneurial self-efficacy as a key driver in technology adoption (Bajaba *et al.*, 2022; Liu and Xi, 2022; Taghizadeh *et al.*, 2022). Digital literacy aligns with the TOE framework, which stresses that organizational readiness to adopt new technologies is influenced by the technological expertise of management and staff (Awiagah *et al.*, 2016; Nazir *at el.*, 2024a).

The role of regulatory trust also emerged as crucial. Entrepreneurs highlighted that clear legal endorsement of digital currencies, similar to digital payment platforms like JazzCash and EasyPaisa, would boost their confidence in adopting cryptocurrencies. This suggests that a well-defined regulatory framework could play a pivotal role in encouraging cryptocurrency adoption, mirroring the relationship between regulatory trust and innovation adoption observed in high-income countries (Balconi *et al.*, 2023; López-Muñoz *et al.*, 2023).

Strategic networking and collaboration also influence adoption. Entrepreneurs, particularly in fintech and IT, participate in both local and national networking events and conferences to stay informed about emerging technologies like fintech, blockchain and cryptocurrency. Many attend industry events, collaborate with blockchain startups, and join knowledge-sharing groups to bridge gaps in understanding and foster technology adoption. This is especially critical in a developing market like Pakistan, where access to information of new technologies can be limited. Networking helps young entrepreneurs overcome resistance to new technologies, as seen in many emerging firms across various industries. From an SCT perspective, entrepreneurs learn by observing their peers, reinforcing the social nature of technology adoption (Li, 2020; Marcati *et al.*, 2008). In Pakistan, this is particularly relevant for young entrepreneurs.

Adaptability and flexibility are also key traits for adopting cryptocurrency. However, the volatility of cryptocurrency markets poses a challenge, particularly for small entrepreneurial firms reliant on stable cash flows. Entrepreneurs expressed caution about the risks, with many preferring traditional methods like cash or bank drafts due to concerns over fluctuating prices. For example, a travel and tourism entrepreneur acknowledged cryptocurrency's potential to reduce transaction costs but was deterred by its volatility. Similarly, a logistics entrepreneur preferred conventional payment methods for their perceived stability. This aligns with literature studies, which note that risk aversion is a significant barrier to technology adoption, particularly in unstable markets (Huang, 2019; Janssen *et al.*, 2020; Koroma *et al.*, 2022).

Digital literacy, strategic networking and adaptability are crucial factors in facilitating cryptocurrency adoption. However, challenges such as market volatility and a lack of clear regulatory frameworks pose significant barriers to broader acceptance. Entrepreneurs' inherent risk aversion highlights the need for well-defined and supportive regulations to build confidence and stability, thereby addressing these obstacles in Pakistan's entrepreneurial sector. This perspective aligns with the findings of Alegre *et al.* (2013), Jalil *et al.* (2022), and Nadeem *et al.* (2021), which emphasize the importance of digital skills, flexibility and collaboration in driving technology adoption.

Finally, our study highlights the crucial role of education and training for senior managers (older employees) in adopting cryptocurrency technologies. Many senior managers resist new technologies, especially those who joined their firms in earlier decades with basic business education. This resistance is often due to a need for more understanding of blockchain and cryptocurrency, making them more risk-averse and less willing to invest in digital innovations (Abaddi, 2024a). For example, a manager from the advertising sector noted difficulty in understanding blockchain and stressed the importance of ongoing training. Similarly, senior real estate and service sector managers were reluctant to adopt cryptocurrencies, fearing job displacement. These findings are consistent with literature suggesting firm management with outdated skills are more likely to resist technological changes (Nazir *et al.*, 2022, 2024a). This study challenges SCT's self-efficacy theory by showing that senior managers' lack of digital skills and fear of job loss impede technology adoption, highlighting the need for targeted training to foster innovation.

7. Conclusions

This study explores the factors influencing blockchain-enabled cryptocurrency adoption among entrepreneurial firms in Pakistan. Aligned with the Finance Minister's initiative for fintech leadership, our research identifies key trajectories affecting cryptocurrency adoption, focusing on the intersection of technology, organization, environment and innovation characteristics of entrepreneurs. This study uses phenomenological qualitative methods to connect the TOE-I framework with SCT to deepen our understanding of the dynamics in various industries in Pakistan.

In conclusion, both internal resistance within entrepreneurial firms due to a lack of entrepreneurial culture and external challenges—such as regulatory, social, cultural and religious uncertainties—pose significant obstacles to cryptocurrency adoption. These barriers highlight the urgent need for a comprehensive and transparent regulatory framework from national and local government authorities to foster innovation, increase market engagement and facilitate the widespread adoption of cryptocurrency among entrepreneurial firms in Pakistan. Without supportive regulations, broader cryptocurrency integration remains constrained.

7.1 Contributions

Our study makes significant theoretical contributions to the literature on cryptocurrency adoption among entrepreneurial firms by integrating the TOE framework and SCT. Previous studies have typically applied these frameworks individually to understand technology adoption (Gemmell *et al.*, 2012; Nguyen *et al.*, 2022; Tri Harinie, 2017). However, our research combines these frameworks for a nuanced understanding of the challenges and opportunities in the adoption process.

Adding the "innovation characteristics of entrepreneurs" to the TOE framework (Tornatzky and Fleischer, 1990), highlights that personal traits like digital literacy are crucial in adopting new technologies, including cryptocurrencies. This shift acknowledges the entrepreneur as a key driver of technology adoption (Balconi *et al.*, 2023; Marcati *et al.*, 2008; Zahra *et al.*, 2023).

Our findings show that digital literacy and self-efficacy (confidence)—necessary in the TOE-I framework and SCT—are vital in decision-making. Entrepreneurs with higher digital literacy and self-confidence are more likely to adopt technologies like cryptocurrency. Many build this confidence through social media platforms like YouTube. In contrast, older managers with less digital literacy often resist these technologies due to outdated education and job loss fears, challenging SCT's assertion that self-efficacy alone drives adoption (Beliaeva *et al.*, 2020; Taghizadeh *et al.*, 2022).

Young entrepreneurs in our study adopt new technologies by observing peers at networking events and knowledge-sharing conferences. These dimensions suggest that SCT factors—self-efficacy (via social media) and observational learning (networking and collaboration)—intersect with the TOE-I framework's focus on digital literacy and networking, which might be less accessible for older employees.

The last dimension of SCT suggests that social and environmental factors, such as social influences, industry dynamics and regulatory frameworks, affect entrepreneurs' decisions regarding innovation adoption (Alegre *et al.*, 2013; Balconi *et al.*, 2023). However, our examination of environmental factors within the TOE-I framework reveals that Pakistani society's traditional social, cultural, and religious barriers hinder entrepreneurs from adopting blockchain innovations. Our TOE-I findings challenge SCT's assertions (Bandura, 1986; Liu and Xi, 2022; Tri Harinie, 2017) and confirm that Pakistan's digital regulatory landscape lacks governmental support, creating uncertainty for firms adopting cryptocurrency. Navigating innovation in these industries remains a significant challenge.

Our study further contributes to the blockchain-enabled cryptocurrency literature by identifying internal and external theoretical factors related to entrepreneurs' technological, organizational, environmental and innovation characteristics.

(1) This study emphasizes the critical role of digital technology infrastructure, including Nostro accounts and crypto-transaction tools, in facilitating technology adoption. To ensure secure adoption, entrepreneurial firms should implement robust KYC protocols to safeguard customer data and mitigate cybersecurity risks. Additionally, improving the trustworthiness and functionality of existing digital platforms, such as JazzCash and EasyPaisa, is essential. Overcoming these technological barriers can pave the way for a more supportive ecosystem for digital innovation.

(2) This study highlights the significance of organizational needs, particularly the importance of digital transformation assets such as financial resources and skilled personnel, including freelancers. It is essential to create an innovation-driven culture through a decentralized, agile structure/departments and embrace digital transaction tools over traditional ledgers. These objectives can be achieved by providing competitive compensation packages to attract and retain top talent.

(3) This study contributes by highlighting the need for a comprehensive digital regulatory framework for cryptocurrency mining, which hinders its adoption. It emphasizes the need to promote digital inclusion by reducing risks through clear regulations, adaptable policies and simplified procedures. Furthermore, the study stresses the importance of fostering cultural and social acceptance of digital tools in a cash-dependent society. It also underscores the critical role of national and local government institutions in facilitating integration and minimizing financial monopolies, which can support the growth of cryptocurrency adoption in entrepreneurial firms.

(4) This study contributes by highlighting the importance of digital literacy, facilitated through social media, networking and participation in events, in promoting cryptocurrency adoption. It identifies key barriers, including market volatility, unclear regulations, traditional cash-based mindsets and resistance from senior managers due to limited education and fear of job loss. The study emphasizes that establishing clear regulations and offering targeted training for senior managers are critical steps in overcoming these challenges and fostering greater cryptocurrency adoption in entrepreneurial firms.

A key contribution of this study is its identification of cultural and religious barriers to cryptocurrency adoption in the context of Islamic finance entrepreneurship. In Pakistan, a Muslim-majority country that adheres to Islamic Sharia law, the concepts of halal and haram significantly influence perceptions of cryptocurrency. Islamic scholars have issued fatwas declaring cryptocurrencies as haram, which, coupled with the government's inability to control the technology backend, reinforces the societal preference for traditional cash-based transactions. Concerns about speculation, uncertainty and interest-based transactions further contribute to these barriers. The study underscores the need to develop Shariah-compliant cryptocurrency frameworks to facilitate broader adoption while respecting religious values.

A significant contribution of our study is its investigation into cryptocurrency adoption among entrepreneurial firms in Pakistan, addressing a gap in existing research that has primarily focused on individual behavior in developed markets (El Chaarani *et al.*, 2024; Huang, 2019; Jegerson *et al.*, 2023, 2024; Sohaib *et al.*, 2020). This paper provides valuable insights into firms' unique challenges in Pakistan's emerging market, highlighting how social, cultural, legal and religious factors differ from those in developed economies. By integrating technological, organizational, environmental and innovation perspectives, our study advances entrepreneurship and innovation research, illustrating the key factors that influence adoption decisions (Balconi *et al.*, 2023; Ince *et al.*, 2023; Liu and Xi, 2022). Furthermore, our emphasis

on entrepreneurs' digital literacy and networking differentiates our work from consumer-focused research (Al Reshaid *et al.*, 2024; Arias-Oliva *et al.*, 2019; Chen *et al.*, 2022). Through a phenomenological qualitative approach, we deepen our understanding of blockchain adoption, enhancing the body of knowledge on these critical issues.

7.2 Implications

The study provides valuable insights for entrepreneurial firms, entrepreneurs, government agencies, academics and the broader cultural context, offering a novel framework for understanding cryptocurrency adoption. By expanding the TOE-I framework and the SCT, we demonstrate their application to new technologies, specifically cryptocurrency. The TOE-I framework is extended by emphasizing the role of technological readiness and organizational factors such as digital literacy and the need for innovation in developing economies. The SCT is applied by highlighting how peer influence, self-efficacy and social learning shape the adoption process, particularly through networking and exposure to successful use cases. These theoretical expansions advance both theoretical and practical approaches to digital financial innovations, particularly in developing economies like Pakistan.

To foster broader adoption, developing Shariah-compliant frameworks that align with Islamic principles is crucial, as well as engaging religious scholars to address fatwa concerns. This can reduce resistance, shift perceptions and promote cryptocurrency adoption while respecting religious values. By expanding the SCT, we recognize how cultural beliefs influence perceptions of legitimacy and the need to integrate these into the adoption process.

Practically, the study highlights the need to bridge financial literacy gaps and address cultural barriers to reduce the stigma surrounding digital currencies. Educating stakeholders and promoting clear, well-defined regulations can enhance business operations and financial practices, allowing entrepreneurial firms to participate more effectively in the digital economy. Leveraging the TOE-I framework, entrepreneurial firms can use organizational resources like skilled personnel and digital infrastructure to adopt cryptocurrencies effectively.

Entrepreneurial firms can leverage these findings to navigate challenges and seize opportunities related to cryptocurrency adoption, such as investing in compliance measures, enhancing security protocols and adopting relevant technologies. The study also emphasizes the importance of digital literacy, especially among older employees, to foster innovation and adaptability within organizations, building on the TOE-I's emphasis on organizational readiness.

Government agencies are encouraged to establish transparent digital regulations to build investor confidence and stimulate technological innovation. Institutions like SMEDA and the State Bank of Pakistan should focus on creating clear regulatory frameworks, implementing targeted educational programs and fostering international collaborations to facilitate digital financial growth, in line with the TOE-I framework's environmental factors.

The study suggests incorporating blockchain and cryptocurrency topics into academic curricula to equip students with essential skills and encourage collaborations with local and national bodies to develop accredited programs. These initiatives will prepare the next generation for active participation in the evolving digital financial landscape, reinforcing the importance of education and social learning, key elements of the SCT.

7.3 Limitations and future research directions

The qualitative nature of this study, centered on entrepreneurial firms in Pakistan's urban financial hubs, presents limitations in generalizability. While the extended TOE-I and SCT frameworks offer valuable insights, they may not fully account for the rapidly evolving dynamics of cryptocurrency adoption. Future studies should consider refining these frameworks or integrating additional models to provide a more comprehensive understanding of the associated challenges and opportunities.

Exploring the interplay between SCT factors and the TOE-I framework, particularly in technological and organizational dimensions, could lead to developing a more holistic model. Longitudinal studies are also recommended to evaluate the long-term effects of cryptocurrency adoption on entrepreneurial firms' performance, growth and sustainability.

Broadening the scope of research to include comparative studies across diverse industries, geographic regions and rural areas would enhance the findings' generalizability and provide a more inclusive perspective on cryptocurrency adoption.

Addressing these areas in future research will contribute to a deeper, more nuanced understanding of cryptocurrency adoption among entrepreneurial firms. This, in turn, can inform strategies and policies to support their digital transformation and drive innovation in the broader economic landscape.

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Further reading

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