

Digital Payment Systems and Fintech Innovations

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Abstract

This study examines the development of digital payment systems and the impact of FinTech innovations on payment methods within a theoretical framework. It explores the historical evolution of online payment methods, mobile wallets, “Buy Now, Pay Later” (BNPL) applications, and the contributions of alternative credit models to financial inclusion. Furthermore, the study discusses the technological innovations introduced by the FinTech ecosystem, as well as the transformations in the financial system brought about by cryptocurrencies and blockchain-based payment solutions. While digital payment systems provide speed, security, and accessibility, they also pose new challenges related to regulation, security, and the protection of consumer rights. In this context, the study not only evaluates the current state of digital payment systems but also aims to provide guidance for future research.

1. Introduction

With the rapid advancement of digitalization in both the marketing and finance sectors, digital payment systems in particular have become an indispensable part of the modern financial ecosystem. Alongside the widespread adoption of electronic commerce, users now have the opportunity to carry out financial transactions more quickly, at lower cost, and with greater accessibility. As payment systems undergo digital transformation, mobile payment applications and digital wallets have largely surpassed the use of

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physical cards, making the user experience smoother and more accessible. In addition, alternative credit models such as “Buy Now, Pay Later” (BNPL) have emerged as rising examples among the new financing methods offered by FinTech. Such innovations provide individuals with flexibility in their financial decision-making processes and enable different segments of society to become included in the financial system.

FinTech is not merely a single technological application or service; rather, it is a broad ecosystem in which financial services are integrated with modern technologies such as digital platforms, big data, artificial intelligence, and cloud computing. Subfields such as Smarter FinTech or PayTech, InsurTech, and LendTech have been studied to show how FinTech plays a transformative role across various segments of the financial sector. In addition, embedded finance is regarded as a significant component of this ecosystem, as it integrates financial services into non-financial platforms, thereby offering broader accessibility and enhancing the user experience. In recent years, the subject of FinTech has attracted considerable attention from both practitioners (such as financial institutions and banks) and academics, leading to a growing body of scholarly research on the topic. A review of the literature reveals that studies have examined the applications of FinTech and their impacts on the banking sector (Vives, 2017; Navaretti et al., 2018; Çağıl & Candemir, 2019; Korkmazgöz & Ege, 2020; Thakor, 2020; Danacı & Çetintaş, 2020; Cankat & Taşseven, 2023; Keskin, 2025), the effects of FinTech applications on the agricultural sector (Küçükarpacı & Ülev, 2023; Rufaidah et al., 2023; Rayhan et al., 2024), as well as their use and development in other areas of finance (He et al., 2017; Alt et al., 2018; Demirdöğen, 2019; Erden & Topal, 2021; Binici, 2022; Çakar, 2023; Kaplan, 2025).

Cryptocurrencies and blockchain-based payment solutions stand out among the developments that emphasize the concepts of trust, transparency, and decentralization in the financial system. Owing to its distributed structure, blockchain technology ensures that transactions are immutable and traceable, thereby reducing the role of traditional intermediaries. The adoption of cryptocurrencies as a means of payment accelerates cross-border transactions and reduces costs. Nevertheless, these technologies also introduce new debates regarding financial stability, regulation, and security. Thus, digital payment systems emerge as a significant area of innovation that transforms traditional structures and shapes the future of the financial world.

The study addresses the financial impacts of digital payment methods and FinTech innovations on the retail sector. It examines the transformation

of digital payment methods, with a particular focus on mobile wallets, buy now pay later (BNPL), alternative credit, the FinTech ecosystem, cryptocurrencies, and blockchain-based payment methods.

2. The Evolution of Digital Payment Methods: Mobile Wallets, Buy Now Pay Later, and Alternative Credit

The journey of digital payment methods began in the 19th century with electronic funds transfers (EFT), which made it possible to transfer money without physical delivery through institutions such as Western Union. This method can be regarded as the first step in the “electronification” process of payment systems. Subsequently, the launch of Diners Club in the 1950s marked the emergence of modern credit cards, followed by the widespread adoption of magnetic stripe cards in the 1970s and debit cards in the 1980s. In this way, card-based payment systems became the foundation of financial transactions worldwide (Kaiman, 2024; Yıldız, 2021).

Toward the late 1990s and early 2000s, the rise of online payment systems brought about a profound transformation in payment infrastructures. Third-party payment gateways and online banking solutions provided the essential infrastructure for users to conduct secure and fast transactions over the internet. The first online payment systems, developed in 1994, enhanced the security of online payments by reducing the need for users to manually enter their credit card information, while intermediary platforms such as PayPal in the early 2000s further strengthened this process (Lokhande, 2025). This digital transformation made payment experiences more accessible and user-friendly.

By the 2010s, mobile wallets and contactless payment technologies (particularly NFC- and QR code-based payment systems) began to see increasing adoption. Mobile wallet applications such as Apple Pay (2014) and Samsung Pay, supported by technologies like Near Field Communication (NFC), enabled smartphones to be used as a means of payment. In addition, QR code-based payments became especially widespread in Asia; platforms such as Alipay and WeChat Pay made contactless payment systems through QR codes commonplace (Bozpolat & Seyhan, 2020). D nyada olduĐu gibi T rkiye’de son yıllarda kullanılan  deme sistemlerinde  nemli bir deĐiŐim ger ekleŐmiŐtir. Bu kapsamda Tablo 1, T rkiye’deki diĐital  deme sistemlerindeki deĐiŐimi g stermektedir (T rkiye Bankalar BirliĐi, 2024).

Table 1. Shopping Transactions: Transaction Amounts (Billion TL)

Transaction Type	2019	2020	2021	2022	2023
Domestic Credit Card	820	939	1,372	2,870	6,490
Installment Credit Card	193	232	336	727	1,652
International Credit Card	23	19	34	84	209
Domestic Debit Card	132	185	298	732	1,490
International Debit Card	2.1	3.8	8.8	23	52
Prepaid Card	3.9	8.5	27	66	143
MOTO + Internet	278	361	595	1,316	2,789
Commercial Card	209	265	434	973	1,970
Mobile Contactless	0.1	0.7	1.7	4.7	11.2
QR Code	–	0.3	0.7	4.0	16.6

Source: Türkiye Bankalar Birliği, 2024.

Today, the evolution of digital payment systems has entered its next stage with the advent of real-time payment infrastructures and crypto technologies. At the same time, blockchain and cryptocurrency technologies are adding new dimensions to payment systems based on decentralization, transparency, and trust, paving the way for e-wallets and digital asset systems. Alongside these developments, mobile wallets, buy now pay later (BNPL), and alternative credit payment methods have become widely used digital payment solutions in the present day.

Mobile wallets have revolutionized the field of financial transactions with the widespread adoption of smartphones. Through NFC (Near Field Communication), QR codes, and application-based digital wallets, users are able to make fast and secure payments without the need for physical cards or cash. Recent academic studies indicate that perceived usefulness and ease of use increase the intention to adopt mobile wallets among individuals with high levels of personal innovativeness. Furthermore, security and communication activities have been emphasized as critical factors influencing users' inclination toward mobile payment systems (Aydın & Burnaz, 2016). At the same time, mobile wallets enable high-volume retail transactions to be conducted quickly and securely.

Buy Now, Pay Later (BNPL) systems stand out as an alternative mechanism that provides users with flexible payment opportunities without relying on credit card limits or applying for loans. BNPL systems are evolving in line with the digitalization of consumer needs and, in particular,

offer consumers payment convenience in sectors such as tourism (Sandıkcı & Şaykol, 2024). BNPL applications can serve as an accessible alternative source of financing for consumers who either cannot access traditional credit systems or prefer not to use credit. Moreover, systematic reviews emphasize that BNPL has emerged as a prominent category within “FinTech payment applications” (Alkadi & Abed, 2023).

Alternative credit refers to innovative financing methods developed outside the traditional banking system, particularly designed for individuals with limited financial access and small businesses. This concept encompasses various mechanisms such as peer-to-peer lending, crowdfunding, FinTech-based microloans, and Buy Now Pay Later (BNPL) applications (Alkadi & Abed, 2023). Alternative credit models stand out as tools that enhance financial inclusion in developing countries, especially for younger populations, low-income households, and newly established enterprises. Moreover, they also play a strategic role in the growth of the FinTech ecosystem.

3. The FinTech Ecosystem and Its Impact on Payment Systems

The concept of FinTech, which emerges from the combination of finance and technology, has been defined in various ways. According to international audit and consultancy firms, it refers to financial technologies that support the use of innovative business models with the aim of enabling, facilitating, and expanding financial services (EY, 2017). In financial markets, FinTech applications are generally employed to enhance efficiency and effectiveness. Defined as a service sector that utilizes mobile-based information systems and advanced technologies, FinTech is frequently applied in areas such as banking and mobile banking, wealth management, financial consulting, electronic money transfers, and cryptocurrencies (Özkan & Cengiz, 2023:7).

The development of FinTech applications has taken place in three stages, as outlined below (Arner, 2015: 51):

FinTech 1.0 Period (1860–1967): This phase marks the initial era in which financial services began to intersect with technology. During this period, technology costs were considerably high, limiting the adoption of such practices to only a few firms. In this respect, FinTech 1.0 is also known as the period when cross-border money transfers began.

FinTech 2.0 Period (1967–2008): This period marks the stage in which the financial industry adapted to the process of digitalization, and nearly all segments of the financial sector shifted toward the use of FinTech. During this era, finance and technology became accessible to the wider public. With the widespread adoption of both the internet and mobile technologies,

investments and the provision of sophisticated financial services were also significantly enhanced.

FinTech 3.0 Period (2008–Present): Beginning with the 2008 financial crisis, this period represents the emergence of new financial systems and the adaptation of the financial industry to the development of financial technologies. It is also the phase in which innovation and start-ups began to expand globally. Rather than being limited to banks, solutions and products started to be offered directly to customers, with significant advancements such as cryptocurrencies like Bitcoin gaining attention, and new financial products being introduced to the stock markets on an ongoing basis. Since 2008, FinTech applications have been actively integrated into financial markets, creating their own ecosystem in light of internet and technological progress. Mobile payment systems have become pioneers of this transformation. FinTech applications have found a place in nearly every stage of banking operations, leading to an expansion in the services offered within this framework.

FinTech is a method that seeks to facilitate economic life through applications such as payments, collections, money transfers, EFT, capital market transactions, money market transactions, and smart contracts. FinTech innovations, offering customers novelty, convenience, and cost savings, aim to compete with traditional financial methods (Akkan, 2018:3). Within these competitive strategies, the accounting treatment of mergers and acquisitions—undertaken by firms to enhance growth and market power—and their effects on financial performance constitute an important area of research (Baral, 2025). Nevertheless, both the opportunities and threats associated with the use of FinTech applications need to be considered simultaneously. The opportunities and threats related to FinTech applications are presented below in Figure 1 (Firmansyah & Anwar, 2019: 56).

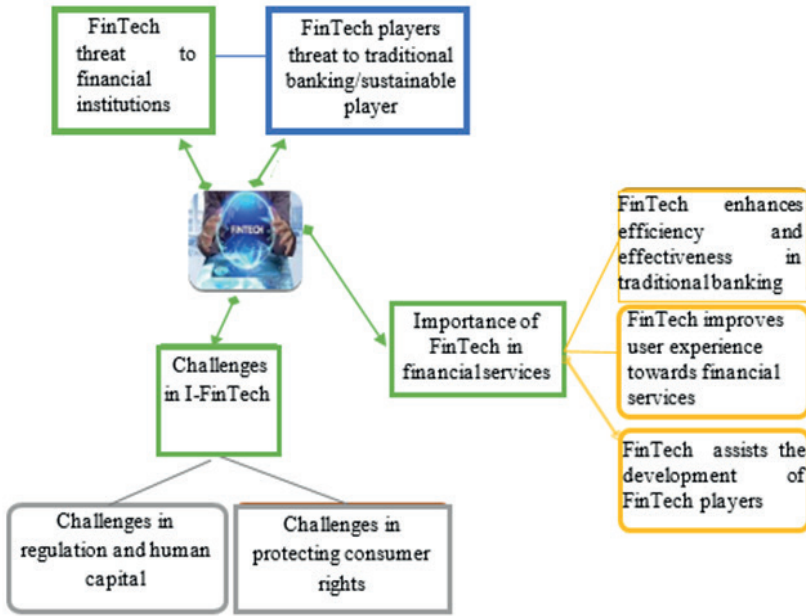


Figure 1: Opportunities and Threats of FinTech Applications
Source: Abd Rani et al., 2021

The most commonly used FinTech applications in financial markets are as follows (Aksoy & Bilgel, 2019: 1099):

- Peer-to-peer lending
- Personal financial management
- Payment methods (e-money companies, digital payments)
- Blockchain and cryptocurrencies
- Digital banking
- Microinsurance
- Crowdfunding
- Financial API economy
- RegTech (models that digitalize regulations)
- Money market-oriented FinTech models

There are several actors within the FinTech ecosystem. These include government policies and incentives, financial institutions, start-ups, new technologies, infrastructure quality, investors, regulations, entrepreneurs,

and consumers. Among these, government policies and incentives constitute the structure that drives the largest expansion or contraction of the FinTech ecosystem. The most important actors, however, are recognized to be entrepreneurs. Financial institutions within the ecosystem are working to adopt new technologies and respond more rapidly to demands (Yeşilyurt & Şuşoğlu, 2021: 70–71). The FinTech ecosystem is presented in detail in Figure 2.

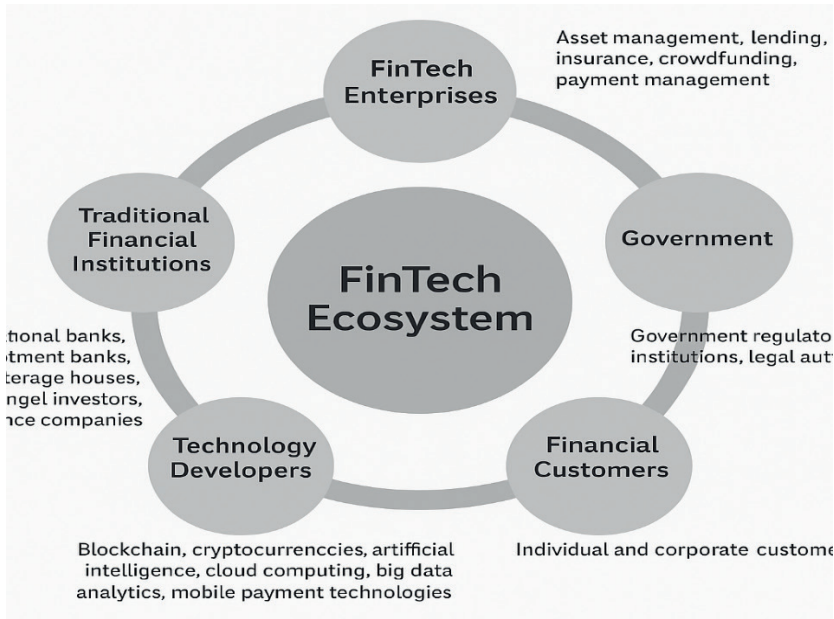


Figure 2. Fintech Ecosystem

Source: Lee, 2016

Businesses seek to take part in and integrate into the FinTech ecosystem. Companies that join and operate within the FinTech ecosystem are classified into three groups according to their size and structure. The first group consists of start-ups and small enterprises. These represent businesses in their establishment phase. Leveraging advanced technology, such firms generally target niche markets. Since 2014, the development of Bitcoin and blockchain technology has been a notable example of this (Avnimelech & Teubal, 2006:1478). The second group includes unicorn start-ups, also referred to as consolidated ventures. These are technology firms with a market valuation of approximately 1 billion USD. Stripe, One97, Ripple, and Coinbase are examples of such companies (Özkan & Cengiz, 2023:9). The third group comprises large FinTech enterprises. Compared to the

others, these businesses are larger in scale, more experienced, and more established, providing services in a broader range of technological fields. PayPal, Visa, Equifax, Lending Club, ACI Worldwide, and S&P Global can be cited as examples of large FinTech enterprises (Breidbach et al., 2020:81).

Technological innovations such as FinTech have also enabled information technologies to be delivered to consumers through mobile applications. In response to the increasing demands of consumers, FinTech entrepreneurs have begun to offer mobile applications and services through new financial software (Bulut, 2019:16; Sezal, 2020:237). Mobile payments, e-wallets, digital money transfers, and digital currencies are among these payment methods. Digital payment applications that facilitate payments via devices such as smartphones, tablets, and mobile wireless devices are among the payment solutions provided by FinTech entrepreneurs. Examples include Apple Pay, TransferWise, Android Pay, and PayPal Mobile Express (Chen et al., 2018:2067; Ashay & Joon, 2016:162).

Payments developed through FinTech innovations address different markets. The first of these is the consumer market, where consumer and retail payments are carried out. The second is the wholesale and corporate market, where wholesale and institutional payments take place. Payment systems, which are not adequately regulated by law, represent the most widely used individual financial services (Lee, 2016:60). The payment services offered by FinTech innovations are examined under four main categories (Taştan & Uralcan, 2019:51):

Mobile Wallets: A mobile wallet is defined as a payment system in which various mobile payment applications or different types of cards are stored together (İşler & Gülaç, 2017:57). Mobile payment systems are divided into hot wallets and cold wallets. Mobile wallets connected to the internet are referred to as hot wallets, while those not connected to the internet are called cold wallets. Hot wallets are mostly downloaded to computers and used as desktop or online applications, via cloud systems, or installed on mobile phones. Cold wallets, on the other hand, are stored on hardware devices or generated on paper in offline form and are considered more secure compared to hot wallets (Güven & Şahinöz, 2018:17). Mobile wallets also allow users to carry fewer cards and physical wallets.

Peer-to-Peer (P2P) Payment Model: Emerging through FinTech lending, this payment model is defined as peer-to-peer lending. In this model, which establishes communication via the internet, lenders and borrowers are brought together by a FinTech company (Demirdöğen, 2019:314). According to another definition, it is described as a “financial exchange” that

takes place between individuals without the intermediation of traditional financial banking institutions (Hulme & Wright, 2006; Sezal, 2020:239).

Remittance and Foreign Exchange Transactions: These include transactions generally carried out through e-money products, traditional bank accounts, cryptocurrencies, or a combination thereof. FinTech simplifies procedures such as remittances and foreign exchange transactions, reduces money transfer fees, and can be effective in international money transfers (Demirdöğen, 2019:314).

Digital Currency and Real-Time Payment Solutions: The payment models evaluated under this heading are mostly known as services provided by FinTech companies in developing countries, where cash is predominantly used in retail payments and credit cards are not widely adopted. These services are utilized for peer-to-peer transfers, bill payments, and e-commerce transactions (Demirdöğen, 2019:314).

With FinTech innovations, the digitalization of payment systems and the introduction of innovative technologies have emerged as major advantages. Thanks to these innovations, payment systems, digital wallets, and mobile payment applications have advanced, making money transfers faster and easier (Menteş, 2019:170). Beyond payment systems, innovations such as mobile wallets, the P2P payment model, and alternative credit scoring systems have opened new avenues for meeting the financing needs of both businesses and individuals. Moreover, payment systems have enabled the automation and personalization of processes in investment and savings decisions for enterprises and individuals (Gülbaşı & Karahan, 2023:301; Umarbeyli & Arabacıoğlu, 2025:90). Another advantage of mobile wallet payment systems for users is that they allow payments to be made anytime, anywhere, and under any condition through a single payment system—without the need to constantly carry cash, credit cards, or debit cards. In addition, various discounts and promotional campaigns are offered to encourage the widespread adoption of systems such as digital and mobile payments, which individuals can benefit from (Gülbaşı & Karahan, 2023:304).

In addition to all these, financial services such as FinTech payment systems also reduce customer costs. They provide opportunities both by lowering operational expenses and by offering cost-effective services. For instance, services such as artificial intelligence play an active role in enabling individuals to carry out more secure, transparent, and convenient money transfers and in making more effective investment decisions (Sezal, 2020:237). FinTech applications also offer significant advantages in terms of accessibility. In particular, they contribute to increasing access to financial

services by providing alternative solutions for individuals and businesses that cannot access, or have limited access to, banking services. With the speed and efficiency of mobile payments and digital wallets, money transfers can be carried out without any loss of time (Erden & Topal, 2021:71).

While FinTech innovations in payment systems offer significant advantages, they also present certain challenges. In particular, the existence of regulatory barriers and frequent updates sometimes create difficulties for users in adapting to the process (K m rc o  lu & Akyaz , 2020:43), leading them to revert to traditional payment systems. Another negative aspect encountered is the occurrence of security breaches. As the use of digital services (in payment systems) increases, so too do security risks, putting users' personal data at risk. Situations such as data breaches and cyberattacks not only harm customers but also cause reputational damage to the sector (Bulut & Aky z, 2020:230). Particularly in managing these risks across the broader financial system and public fiscal administration, ensuring legal compliance relies critically on the effectiveness of institutional internal control frameworks such as COSO (Baral &  ak rsoy, 2023). To manage such operational and reputational risks and to maintain competitive strength, it is important for businesses to utilize artificial intelligence-based systems such as Fuzzy Logic, particularly under conditions of uncertainty, in order to estimate cost components that exhibit variability (such as security and compliance costs) (Baral & Aslan, 2018).

4. Cryptocurrencies and Blockchain-Based Payment Systems

The concept of blockchain was first mentioned in 1991; however, it later became more commonly associated with cryptocurrencies such as Bitcoin and Ethereum. Blockchain technology, which is predominantly utilized in the financial sector ( nsal & Kocao  lu, 2018:58), is defined as a distributed ledger technology. By validating transactions, blockchain eliminates the need for third-party intermediaries and provides an additional layer of trust. Moreover, it functions as a broad combination of distributed systems, cryptography, and various other technologies (Gorkhali et al., 2020:330). Blockchain technology is also described as a decentralized structure that enables up-to-date data storage and is primarily used for cryptocurrencies. This characteristic adds value to blockchain in terms of reliability and transparency (Namasudra et al., 2021:1501).

A review of the literature shows that blockchain technology addresses a wide range of needs. Therefore, different types of blockchain have been developed and classified under three main categories. The types of blockchain are presented in Figure 3.

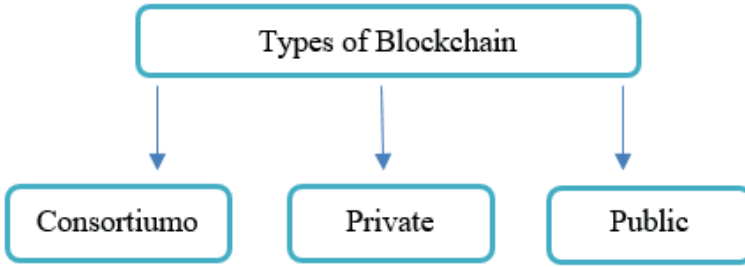


Figure 3. Types of Blockchain
Source: Ceylan & Işık, 2023:137

There are three types of blockchain technology: consortium, private, and public (Ceylan & Işık, 2023:137).

The use cases of blockchain technology are also quite extensive. Among them are cryptocurrencies, digital identity, customer recognition, payment systems, supply chains, crowdfunding, insurance, healthcare services, and voting. One of the application areas of blockchain technology, cryptocurrencies, are digital currencies that can be transferred electronically from one user to another without intermediaries. Cryptocurrencies are not tied to any institution or organization (İslam, 2019: 60-62).

The cryptocurrencies used within blockchain technology operate on public blockchains, which allow transactions to be carried out openly by anyone (Ceylan & Işık, 2023:137). With blockchain technology, cryptocurrencies conduct all transactions without the need for a central authority. This demonstrates that cryptocurrencies are secure and reliable (Mendi, 2021:184). Blockchain also provides an advantage in terms of transaction fees for cryptocurrencies and enables transactions to be completed quickly. As a result, cryptocurrencies conduct transactions in markets in a more secure, reliable, and cost-effective manner (Türkmen & Durbilmez, 2019:35).

Blockchain technology and cryptocurrencies provide a highly secure, fast, and decentralized method of payment. It is evident that this technology has a suitable structure for being used in payment systems (Takaoğlu et al., 2019:267). Payments made through this technology are not managed by any central authority, and transactions are carried out directly without the need for intermediaries. This ensures that payments are processed both more quickly and at lower cost. Moreover, payments made via blockchain

technology and its core element, cryptocurrencies, play a significant role in terms of security (Namasudra et al., 2021; Chen et al., 2018).

Payments within blockchain- and cryptocurrency-based systems are encrypted using cryptographic algorithms. These transactions are verified by all users in the system, preventing manipulation or fraudulent transactions. Another feature of this technology in terms of payments is its versatility. Payments are not limited to traditional methods such as physical cash or credit cards but can also be made through digital currencies or other digital assets. Furthermore, the direct execution of payments, prevention of manipulation, and versatile nature make blockchain technology and cryptocurrencies an attractive option for payment systems (Ceylan & Işık, 2023:145).

5. Conclusion

Digital payment systems have played a central role in the transformation of financial services, witnessing a rapid evolution from traditional methods to digital solutions. Online payment methods, in parallel with the development of electronic commerce, have enabled users to make secure, fast, and cost-effective payments, thereby transforming consumer behavior in the process. In particular, online banking and third-party payment providers have created an important infrastructure for the growth of the digital economy.

Methods such as mobile wallets and Buy Now Pay Later (BNPL) demonstrate that digital payment systems have evolved beyond being merely a transaction tool, becoming a structure that enhances financial accessibility and offers flexibility to consumers. While mobile technologies reduce the use of cash and cards in daily life, models such as BNPL provide new flexibility in consumer purchasing behavior. These developments not only support financial inclusion but also bring about new risks and regulatory requirements.

With the growth of the FinTech ecosystem, payment systems have become not only a technological innovation but also a paradigm shift that reflects the structural transformation of the financial sector. Big data, artificial intelligence, cloud computing, and embedded finance solutions enable payments to be delivered in a more personalized, accessible, and cost-effective manner. In this way, FinTech innovations have reshaped both the business models of financial institutions and the expectations and habits of consumers.

Cryptocurrencies and blockchain-based payment solutions have created a dimension in the future of digital payment systems that emphasizes the principles of trust, transparency, and decentralization. These technologies

provide speed and cost advantages, particularly in cross-border transactions, while at the same time raising debates in terms of regulation, security, and financial stability. Therefore, blockchain- and crypto-based payments are positioned both as an important component of financial innovation and as a focal point of regulatory discussions.

In conclusion, digital payment systems and FinTech innovations have brought significant gains in terms of accessibility, speed, security, and flexibility within financial services. However, this transformation process also introduces new responsibilities regarding regulation, security, and the protection of consumer rights. Future research should more comprehensively examine the impact of technological innovations on financial inclusion and develop policy recommendations aimed at ensuring that these systems evolve into sustainable, secure, and inclusive structures.

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