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Cybersecurity Challenges in Indian Fintech Start-Ups: A Regulatory Lens

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Abstract

The rapid growth of fintech start-ups in India has transformed the financial services landscape by accelerating innovation in payments, digital lending, wealth management, and insurance while promoting financial inclusion. However, this digital expansion has simultaneously exposed fintech start-ups to significant cybersecurity risks due to limited resources, evolving technologies, and complex regulatory requirements. This study examines the cybersecurity challenges faced by Indian fintech start-ups through a regulatory lens, identifying key threats such as data breaches, identity theft, phishing attacks, ransomware incidents, and vulnerabilities arising from third-party integrations. This paper maps the evolving cybersecurity governance structure shaped by regulatory and institutional mechanisms, including those of the Reserve Bank of India, the Digital Personal Data Protection Act, Securities and Exchange Board of India frameworks, and CERT-In directives. Using a synthesized analytical framework, the study categorizes cybersecurity risks into technological vulnerabilities, data privacy concerns, and operational challenges specific to start-ups. It further analyses sector-specific risks while aligning them with regulatory responses such as digital lending norms, data localization requirements, and sandbox-based compliance mechanisms. Drawing on recent developments and governance perspectives, the paper highlights the limitations of fragmented oversight and underscores the need for harmonized, adaptive, and innovation-friendly cybersecurity regulation. The findings contribute to a structured understanding of the interplay between fintech innovation, cyber risk exposure, and regulatory preparedness, offering policy-relevant insights for strengthening resilience in India's rapidly evolving fintech ecosystem.

Keywords: Fintech Start-ups, Cybersecurity, Cyber Risks, Regulatory Framework, Data Protection, Compliance

JEL Classification: M13, G18, K24, G28

1. Introduction

The growth of fintech in India has transformed the financial sector by driving innovation in banking, payments, lending, and insurance while expanding financial inclusion and introducing new business models. However, this rapid digital transformation has also exposed fintech start-ups to significant cybersecurity risks due to limited security maturity and increasing dependence on digital infrastructure.

This study examines key cybersecurity challenges, including ransomware, phishing, identity theft, data breaches, and third-party risks, through a regulatory perspective. It reviews the roles of the Reserve Bank of India (RBI), the Digital Personal Data Protection (DPDP) Act, SEBI's cybersecurity frameworks, CERT-In guidelines, and other institutional mechanisms in shaping India's cybersecurity landscape. It also highlights

the complexities of the country's multi-regulator framework, where overlapping responsibilities require effective coordination.

The study classifies cybersecurity risks into three dimensions—technological vulnerabilities, data privacy concerns, and start-up-specific operational challenges—and aligns them with emerging regulatory measures such as digital lending norms, data localization requirements, and regulatory sandbox mechanisms. It further examines the relationship between innovation, cyber risk, and regulation, emphasizing the need for adaptive and harmonized cybersecurity governance to strengthen resilience while sustaining India's leadership in the global fintech ecosystem.

2. Literature Review

2.1. Fintech Revolution and Financial Transformation in India

The growth of fintech in India has transformed the financial services sector through innovations in banking, payments, lending, and insurance. Research shows that the fintech ecosystem has evolved from basic payment solutions into a comprehensive digital ecosystem that is reshaping traditional financial services [1] [2]. The Indian fintech market is projected to reach US$1 trillion by 2030, reflecting its rapid growth and economic significance [3]. This transformation has expanded financial inclusion by reaching underserved populations and introducing innovative business models that have redefined customer engagement, risk assessment, and service delivery [4][7][10].

2.2. Cybersecurity Vulnerabilities in the Fintech Ecosystem

The shift toward digital financial services has exposed the fintech sector to significant cybersecurity risks that threaten the stability and integrity of the financial ecosystem. The literature identifies five major threat categories: data breaches, identity theft, phishing attacks, ransomware, and third-party risks [16]. Fintech start-ups often lack the security maturity and infrastructure needed to address increasingly sophisticated cyber threats, making them particularly vulnerable. Given the sensitivity of financial data and the critical role of fintech platforms, these vulnerabilities pose significant risks. Studies also highlight that financial data are prime targets for cybercriminals due to their value in fraud and identity theft [9], while security breaches can affect the broader digital financial ecosystem and undermine public trust [12].

2.3. Multi-Agency Regulatory Landscape in India

The regulatory environment in India's fintech sector is characterized by a multi-agency approach, each with distinct mandates and areas of focus, creating both comprehensive coverage and potential overlaps in oversight. The literature extensively documents this complex regulatory architecture, identifying key regulatory bodies, including the Reserve Bank of India, the Securities and Exchange Board of India, the Insurance Regulatory and Development Authority, and the newly established Data Protection Board. Research shows that this multi-regulator model creates significant compliance challenges for fintech companies, particularly start-ups across multiple financial domains [18][19]. Evidence suggests that the regulatory landscape has evolved significantly in response to emerging cybersecurity threats. The Reserve Bank of India's Master Direction on Cyber Security [27] and SEBI's Cyber Security and Cyber Resilience Framework represent cornerstones of India's fintech cybersecurity regulatory approach [32][33]. Research indicates that the Digital Personal Data Protection Act (2023) has further strengthened data protection requirements. However, implementation challenges remain significant, particularly for resource-constrained start-ups [13].

2.4. Categorization of Cybersecurity Challenges

This categorizes cybersecurity threats into three dimensions: technological vulnerabilities, data privacy concerns, and start-up-specific operational challenges, providing a structured framework for analysing risks across fintech business models and regulatory domains. The literature supports this classification as an effective approach to understanding the interplay among different cyber threats [15]. Technological vulnerabilities include application security flaws, infrastructure misconfigurations, API weaknesses, and emerging technologies such as artificial intelligence, blockchain, and the Internet of Things, which introduce new attack surfaces [15]. Data privacy concerns focus on consent management, data localization, and cross-border data transfers [19]. Operational challenges unique to start-ups, including resource constraints, scalability issues, and weak security culture, further increase their exposure to cyber threats [8].

2.5. Sector-Specific Risks and Regulatory Responses

Moreover, the literature examines sector-specific cybersecurity risks and aligns them with current and emerging regulations, including digital lending norms, data localization mandates, and regulatory sandbox mechanisms. Different fintech segments face distinct cybersecurity challenges requiring tailored regulatory approaches. The digital payments sector, processing over 10 billion UPI transactions monthly, relies on tokenization, end-to-end encryption, and rigorous audits to mitigate transaction interception and API vulnerabilities [22][23][27]. Digital lending platforms primarily face identity theft and synthetic fraud risks, with the RBI's Digital Lending Guidelines strengthening consumer protection while increasing compliance requirements for smaller firms [29]. Wealth management platforms are largely governed by SEBI's cybersecurity framework, whereas blockchain and cryptocurrency platforms present emerging regulatory challenges due to their jurisdictional complexity [34].

2.6. Innovation, Risk, and Regulation Dynamics

Extracting on real-world incidents and regulatory developments, the literature highlights the complex relationship between innovation, cybersecurity risk, and regulation in India's fintech ecosystem. It emphasizes the need to balance innovation with security, as overly restrictive regulations may hinder technological advancement, while inadequate oversight can expose the financial system to significant risks [24]. Regulatory sandboxes have emerged as effective mechanisms for testing innovative solutions in controlled environments while managing security risks [19]. Studies further suggest that maintaining India's position as a global fintech leader requires adaptive and harmonized cybersecurity governance capable of addressing emerging technologies and evolving threats [34]. Greater coordination among regulatory bodies is essential to reduce fragmentation, strengthen resilience, and support sustainable fintech growth.

3. The Fintech Revolution in India

The methodology describes the design, data, and procedures in enough detail to permit replication. Variables, instruments, and analytical techniques should each be defined precisely.

Table 1. Phases of Evolution in India's Fintech Sector.

Phase	Period	Key Developments	Market Size
Foundational	2010-2015	Digital wallets, payment gateways, Ape's, IMPS	$10 billion
Accelerated Growth	2016-2019	UPI launch, demonetization impact, digital lending expansion	$50 billion
Maturation	2020-Present	Embedded finance, neo-banking, blockchain solutions, and AI integration	$150 billion

Note: Compiled by the authors.

3.1. Evolution and Growth Trajectory

India's fintech journey has evolved from basic payment solutions into a comprehensive financial ecosystem through three distinct phases marked by technological advancement, regulatory development, and market expansion. The foundational phase (2010–2015) witnessed the emergence of digital wallets, payment gateways, and key infrastructure such as the Aadhaar-enabled Payment System (AePS) and Immediate Payment Service (IMPS), laying the foundation for real-time digital payments.

The accelerated growth phase (2016–2019), driven by demonetization and the launch of the Unified Payments Interface (UPI), transformed digital payments through seamless peer-to-peer (P2P) and peer-to-merchant (P2M) transactions. This period also witnessed the rapid growth of digital lending and wealth management platforms, with start-ups such as PolicyBazaar, BankBazaar, and Zerodha gaining prominence [13]. The maturation phase (2020–present) has been characterized by accelerated digital adoption following the COVID-19 pandemic, making fintech an essential component of financial services. This phase has also witnessed the emergence of embedded finance, neo-banking, and blockchain-based solutions, with the sector continuing to attract significant investments despite global economic headwinds [20].

3.2. Key Segments and Innovations

The Indian fintech ecosystem comprises diverse segments, each with distinct value propositions and cybersecurity implications. Digital payments remain the largest and most mature segment, accounting for nearly 22% of the fintech market and over 45% of India's digital transactions through UPI [25]. Innovations such as QR code and NFC-based payments, voice-enabled transactions, and cross-border payment solutions have enhanced financial inclusion but also increased risks related to transaction interception, API vulnerabilities, and phishing attacks.

Digital lending, representing about 27% of the market, has expanded credit access through alternative data-driven credit scoring, BNPL services, and P2P lending platforms. However, AI-based credit underwriting and digital onboarding processes expose the sector to algorithmic manipulation, identity fraud, and synthetic identity risks.

Wealth management and investment platforms, accounting for approximately 15% of the market, have democratized investing through robo-advisory services, micro-investment platforms, and direct mutual fund offerings. These innovations introduce cybersecurity risks, including unauthorized trading, portfolio manipulation, and account takeover.

Insurtech, contributing around 8% of the fintech ecosystem, has transformed insurance distribution and claims processing through digital platforms and telemedicine integration, creating risks related to health data breaches and claims fraud. Similarly, blockchain and cryptocurrency platforms have introduced decentralized finance, smart contract-based services, and cross-border remittances, while facing cybersecurity challenges associated with private key management, smart contract vulnerabilities, and regulatory uncertainty.

3.3. Regulatory Significance of Fintech Growth

The exponential growth of fintech has significant regulatory implications, challenging traditional oversight mechanisms designed for conventional financial institutions. Addressing cybersecurity in the fintech sector requires balancing financial stability, consumer protection, innovation, and market integrity. India's multi-regulator framework provides comprehensive oversight but also creates overlaps that require effective coordination.

The growing systemic importance of fintech platforms, driven by increasing transaction volumes and sensitive data processing, has heightened cybersecurity concerns. As fintech becomes more interconnected with the financial system, cyber incidents can affect financial stability, requiring regulatory frameworks that address both operational vulnerabilities and systemic risks.

Consumer protection has become a key regulatory priority, as fintech's digital-first nature creates challenges in ensuring transparency, fair treatment, and effective grievance redressal. Unlike traditional banks, fintech platforms primarily interact with customers through digital channels, complicating dispute resolution and fraud mitigation.

Balancing innovation with financial stability remains a persistent regulatory challenge. While fintech has advanced financial inclusion and efficiency, it has also introduced emerging risks that existing frameworks may not fully address. Regulatory approaches must therefore evolve to support innovation while ensuring adequate safeguards against cyber threats and other risks.

4. Cybersecurity Challenges in Indian Fintech Start-ups

Table 2. Shows the types of cybersecurity threats in Indian fintech start-ups.

Threat Category	Description	Impact	Regulatory Response
Data Breaches	Unauthorized access to sensitive financial and personal information	Financial losses, reputational damage, and regulatory penalties	CERT-In reporting (6-hour rule), DPDP breach notification
Identity Theft	Fraudulent use of personal information for financial crimes	Synthetic identity fraud, account takeover, and application fraud	Enhanced KYC/AML, digital lending guidelines
Phishing Attacks	Deceptive attempts to obtain credentials or financial information	Credential compromise, unauthorized transactions	MFA requirements, customer awareness programs
Ransomware	Malicious software encrypts data and demands payment	Service disruption, data exfiltration, reputational damage	BCP/DR requirements, payment prohibitions
Third-Party Risks	Vulnerabilities in the supply chain and vendor integrations	Multi-platform breaches, compliance gaps	Due diligence, contractual protections, and monitoring
AI-Powered Attacks	AI-enhanced social engineering and system manipulation	Sophisticated phishing, algorithm manipulation	Emerging guidelines, threat intelligence sharing
API Vulnerabilities	Security flaws in application programming interfaces	Unauthorized access, data exposure	API security standards, monitoring requirements

Note: Compiled by the authors through various sources.

4.1. Data Breaches

Data breaches constitute one of the most pervasive cybersecurity challenges facing Indian fintech start-ups, with potentially devastating consequences for customers, companies, and the broader financial ecosystem. These incidents concern illegal access to private data, including financial information, transaction history, authentication credentials, and personal identification numbers. The average data breach in the financial sector costs approximately $5.85 million globally, with India experiencing a 25% increase in breach costs between 2020 and 2022 [9]. For fintech start-ups, the effects go beyond financial losses, including damage to reputation, regulatory penalties, and customer trust.

Fintech start-ups are particularly susceptible to data breaches due to several inherent characteristics. Data concentration creates attractive targets for cybercriminals, as platforms accumulate vast repositories of sensitive financial information. Immature security infrastructure often results from resource constraints that lead start-ups to prioritize growth and product development over security investments. Complex supply chains expand the attack surface with multiple third-party integrations, as vulnerabilities in any connected system can compromise the entire platform. Rapid scaling often outpaces security systems, creating gaps in protection as companies grow exponentially.

From a regulatory perspective, data breaches trigger multiple obligations across different frameworks. CERT-In's 2022 directives require reporting all data breaches within six hours of detection, covering unauthorized access to systems, data breaches, ransomware attacks, identity theft, web defacement, malicious code attacks, and denial of service attacks. The Digital Personal Data Protection Act mandates notification of affected individuals and the Data Protection Board, with significant penalties for non-compliance. The RBI and SEBI impose monetary penalties for breaches resulting from inadequate security measures, requiring corrective actions, including forensic audits and system upgrades.

4.2. Identity Theft

Identity theft, the unauthorized possession of another person's personal information to perpetrate fraud or other crimes, is a particularly pernicious cybersecurity threat in the finance industry. In digital financial services, identity theft can enable criminals to open fraudulent accounts, apply for loans, conduct unauthorized transactions, or manipulate investment portfolios. A 2022 investigation by Indian authorities uncovered an identity theft ring that had defrauded digital lending platforms of over ₹200 crore by creating 50,000 synthetic identities using stolen personal information and forged documents [21].

The mechanisms of identity theft in Indian fintech manifest through various vectors. Synthetic identity fraud involves creating fictitious identities using real and fabricated information, often targeting digital lending platforms with inadequate verification processes. Account takeover attacks compromise legitimate user accounts through phishing, malware, or credential stuffing, enabling unauthorized transactions. Application fraud uses stolen or forged documents to open accounts or apply for credit products, while social engineering manipulates customer service representatives or automated systems to bypass authentication measures.

Regulatory concerns around identity theft span multiple dimensions. KYC compliance requires fintech companies to implement robust identity verification procedures to prevent financial crimes. Weaknesses in digital onboarding processes can result in regulatory non-compliance and facilitate financial crimes. AML/CFT obligations necessitate enhanced identity verification to prevent money laundering and terrorist financing, potentially triggering sanctions from the Financial Intelligence Unit-India. Consumer protection imperatives require ensuring that fintech companies implement adequate safeguards to protect customers from identity theft and related frauds, with the RBI's 2022 digital lending guidelines specifically prohibiting unauthorized access to customer mobile phones and data.

4.3. Phishing Attacks

Phishing attacks have emerged as a persistent and evolving threat to Indian fintech platforms, exploiting human psychology rather than technical vulnerabilities to compromise security. These attacks involve deceptive attempts to obtain sensitive information by disguising themselves as trustworthy entities in electronic communications. A 2023 report by the National Cyber Security Coordinator revealed that phishing attacks accounted for 36% of all cybersecurity incidents in the Indian financial sector, with fintech platforms experiencing a 45% increase in phishing attempts during the pandemic.

The evolution of phishing attacks against Indian fintech customers has grown increasingly sophisticated. Targeted spear phishing attacks personalize communications using information gathered from social media or previous breaches. Vishing and smishing leverage voice-based (vishing) and SMS-based (smishing) phishing attacks that exploit the widespread adoption of mobile banking. Clone phishing creates nearly identical replicas of legitimate websites or applications to capture login credentials and financial information. Business email compromise targets corporate accounts to initiate unauthorized financial transactions, often compromising significant sums before detection.

Regulatory approaches to mitigating phishing risks include multi-factor authentication requirements, customer awareness programs, fraud monitoring systems, and incident response protocols. The RBI has mandated MFA for all high-value digital payment transactions, significantly reducing the impact of compromised credentials. Regulators expect fintech companies to implement comprehensive customer education initiatives about phishing risks and safe digital practices. Real-time fraud detection and monitoring systems capable of identifying suspicious transaction patterns indicative of phishing-related fraud are required components of regulatory compliance frameworks.

4.4. Ransomware Attacks

Ransomware attacks represent a particularly destructive cyber threat, involving malicious software that encrypts a victim's data, with the attacker demanding payment for restoration. For fintech start-ups, which rely heavily on continuous system availability and data integrity, ransomware poses an existential threat. In 2022, a leading Indian digital lending platform suffered a ransomware attack that encrypted its loan management systems, disrupting operations for 72 hours and affecting over 200,000 loan applications. The company incurred approximately ₹15 crore in costs for system restoration, customer compensation, and regulatory compliance.

The consequences of ransomware attacks extend beyond financial losses. Service disruption can halt payment processing, loan disbursements, and other essential services, directly impacting customers and business operations. Data exfiltration before encryption often occurs, potentially exposing sensitive customer information even if the ransom is paid. Reputational damage from extended service outages can be severe, with recovery often taking months or years. Regulatory scrutiny following significant ransomware incidents can result in intensive investigations, penalties, and mandatory system upgrades.

Regulatory frameworks address ransomware threats through prevention, preparedness, and resilience requirements. Business continuity and disaster recovery plans, including regular testing and offline backup capabilities, are mandated. Payment prohibitions explicitly forbid ransom payments to cybercriminals, which may encourage further attacks and potentially violate sanctions regimes. Incident reporting requirements enable rapid response coordination and threat intelligence sharing. Security controls, including network segmentation, endpoint detection and response systems, and privileged access management, are required to mitigate ransomware risks.

4.5. Third-Party and Supply Chain Risks

Fintech start-ups increasingly depend on third-party providers for cloud hosting, payments, analytics, and customer support, enabling scale but exposing them to significant supply chain risks. The 2023 breach at a primary cloud provider serving multiple Indian fintechs, compromising data of over 5 million customers, underscored these systemic vulnerabilities.

Third-party risks arise through direct compromises of vendors, exploitable software flaws, shared infrastructure issues in cloud and API environments, and compliance gaps from inconsistent vendor security. Regulators address these through due diligence, contractual safeguards, and ongoing monitoring. RBI and SEBI mandate vendor assessments, security clauses, audit rights, and liability provisions, alongside periodic reviews. Shared responsibility models clarify security obligations between fintechs and their providers, especially in cloud environments.

4.6. Emerging Threats

The cybersecurity threat landscape continues to evolve rapidly, with new attack vectors and techniques emerging regularly. Several emerging threats are particularly relevant to the Indian fintech sector. AI-powered attacks leverage artificial intelligence and machine learning to enhance their effectiveness, including deepfakes and synthetic media for social engineering attacks, adversarial machine learning to manipulate AI systems for fraud detection or credit scoring, and automated phishing campaigns at scale. API vulnerabilities have become increasingly significant as fintech platforms rely on APIs for integration and service delivery, with broken authentication, broken authorization, excessive data exposure, and a lack of rate limiting being common issues.

Cloud security risks have grown with the migration of fintech services to cloud environments, including misconfigurations that expose data or systems to unauthorized access, shared responsibility confusion, and multi-cloud complexity. Internet of Things (IoT) security challenges have emerged with the growing use of IoT devices in financial services, including insecure device authentication, firmware vulnerabilities, and inadequate update mechanisms. Quantum computing represents a future challenge that could break the encryption standards used to protect financial data, though current regulations do not adequately address this threat.

Regulators respond to these emerging threats through updated guidelines, enhanced supervision, and collaboration with industry stakeholders to develop appropriate security frameworks. The RBI's 2022 cloud computing guidelines and SEBI's focus on API security represent initial steps in addressing these evolving challenges. However, the rapid pace of technological innovation continues to outstrip regulatory development, creating gaps in protection that require ongoing attention and adaptive regulatory approaches.

5. Regulatory Framework for Cybersecurity in Indian Fintech

Table 3. Key Regulatory Frameworks for Fintech Cybersecurity in India

Regulatory Body	Key Frameworks	Focus Areas	Compliance Requirements
RBI	Master Direction on Cyber Security (2016, updated 2021)	Governance, SOC, vulnerability management, and incident response	Board oversight, annual audits, 6-hour incident reporting
	Digital Lending Guidelines (2022)	Consent management, data access restrictions, and transparency	Explicit borrower consent, no unauthorized device access
	Cloud Computing Guidelines (2022)	Cloud security, third-party risk	Due diligence, data localization, and encryption standards
DPDP Board	Digital Personal Data Protection Act (2023)	Data privacy, consent management, breach notification	Granular consent, data minimization, breach notification
SEBI	Cyber Security and Resilience Framework (2015, updated 2021)	Market infrastructure protection	Algorithm validation, data encryption, and segregation of funds
	Stock Broker Guidelines	System audits, business continuity	CERT-In empanelled auditors, RTO/RPO requirements
CERT-In	Cyber Incident Reporting Directions (2022)	Incident reporting, threat intelligence	6-hour reporting, detailed incident format, PoC designation
	Security Guidelines	Network, application, data, identity management	Secure coding, patch management, and IAM controls

Note: Compiled by the authors from various sources.

5.1. Reserve Bank of India (RBI) Regulations

The Reserve Bank of India, as the central bank and primary financial regulator, has established the most comprehensive cybersecurity framework for the fintech sector. Its regulatory approach has evolved significantly over the years, reflecting the changing threat landscape and the growing importance of fintech in

the financial system. The RBI's Master Direction on Cyber Security (2016, updated 2021) represents the cornerstone of its cybersecurity regulatory framework, applying to banks but with significant implications for fintech companies that partner with or provide services to banks. This comprehensive document mandates the establishment of a robust cybersecurity governance framework with board-level oversight, security operations centers, vulnerability management programs, and incident response capabilities.

The RBI's guidelines for Payment System Operators (PSOs), updated in 2021, outline detailed requirements for entities operating in the payments space, including many fintech companies. These guidelines specify security controls such as end-to-end encryption for all payment transactions, multi-factor authentication for all administrative functions, network segmentation to isolate critical payment systems, and regular security audits by independent auditors. The guidelines also mandate robust business continuity and disaster recovery plans to ensure the resilience of payment systems, along with customer protection measures to prevent fraud and unauthorized transactions.

The RBI's Digital Lending Guidelines (2022) represent a significant regulatory response to emerging risks in the digital lending sector. These guidelines address cybersecurity through requirements for transparent disclosure of lending partners and their roles in the lending process, prohibition of unauthorized access to customer mobile phones and data, and standardized grievance redressal mechanisms with defined timelines. The guidelines also mandate audit and compliance requirements for digital lending platforms, including mandatory reporting of significant cybersecurity incidents and board-level oversight of cybersecurity risks.

In 2022, the RBI issued specific guidelines for cloud computing arrangements, specifying requirements for fintech companies using cloud services. These guidelines emphasize due diligence of cloud service providers, including security certifications and compliance with Indian regulations, data localization requirements for sensitive payment system data, encryption standards for data at rest and in transit, and exit strategies to ensure business continuity in case of cloud service termination.

5.2. Digital Personal Data Protection Act (DPDP Act)

The DPDP Act, 2023, represents a significant milestone in India's data protection landscape, with profound implications for how fintech companies handle customer data and ensure cybersecurity. While not exclusively focused on fintech, the Act establishes comprehensive requirements for data protection that directly impact cybersecurity practices in the sector. The Act mandates explicit and informed consent for data collection and processing, with mechanisms for customers to withdraw consent. It requires data minimization principles, ensuring that only necessary data are collected and retained for specified purposes.

The DPDP Act introduces data localization requirements, mandating that specific categories of data be stored in India, including critical personal data that can only be processed in India. Cross-border data transfers are permitted under specific conditions and safeguards, creating technical and operational challenges for fintech companies with international operations. The Act establishes breach notification requirements, mandating that data fiduciaries report data breaches to the Data Protection Board and affected individuals within specified timelines, with significant penalties for non-compliance.

Security safeguards are a central component of the DPDP Act, requiring the implementation of reasonable security practices and procedures to protect personal data. These include technical measures such as encryption, access controls, vulnerability management, and organizational measures including policies, training, and accountability frameworks. The Act promotes privacy by design and default principles, requiring cybersecurity considerations to be integrated into product development from the outset rather than added as an afterthought.

5.3. SEBI's Cyber Risk Frameworks

As the regulator of securities markets, the Securities and Exchange Board of India (SEBI) has developed comprehensive cybersecurity frameworks applicable to fintech companies operating in the capital markets space. SEBI's Cyber Security and Resilience Framework (2015, updated 2021) outlines detailed requirements for market intermediaries, including fintech platforms providing investment-related services. The framework emphasizes governance requirements for cybersecurity, including board-level oversight and dedicated security teams, risk assessment and management requirements to identify and mitigate threats, and access control and authentication standards, including multi-factor authentication for critical functions.

SEBI's guidelines for stock brokers, many of which now operate as fintech platforms offering discount brokerage services, include specific cybersecurity requirements. These guidelines mandate annual system audits by CERT-In empanelled auditors, covering network security architecture and configurations, application security controls and coding practices, database security and access management, and physical security of data centers and critical infrastructure. The guidelines also require detailed business continuity and disaster recovery plans with regular testing, including recovery time objectives (RTO) and recovery point objectives (RPO) for trading systems.

For robo-advisory platforms and other investment-related fintech innovations, SEBI has established specific regulations that address cybersecurity through requirements for algorithm validation and disclosure to ensure transparency and fairness, data protection and privacy requirements for customer financial information, and audit and compliance requirements to verify adherence to regulatory standards. The framework also includes requirements for portfolio management services to meet SEBI registration and disclosure requirements, maintain performance transparency, and mitigate conflicts of interest.

5.4. CERT-In Directives

The Indian Computer Emergency Response Team (CERT-In) is the national agency that responds to cybersecurity incidents. Its directives have significant implications for fintech companies' cybersecurity practices. CERT-In's 2022 directions on cybersecurity incident reporting apply to all entities, including fintech companies, and require compulsory reporting of specified cybersecurity incidents within six hours of detection. The reportable incidents include unauthorized access to IT systems, data, or resources, data breaches, ransomware attacks, identity theft, web defacement, malicious code attacks, attacks on servers, applications, or critical infrastructure, attacks on cloud services, social engineering or phishing attacks, and denial of service attacks.

CERT-In has issued comprehensive cybersecurity guidelines applicable to organizations, including fintech firms. These guidelines include security policies, network and application security, data protection, identity and access management, and incident response procedures. They make detailed technical recommendations on everything from securing network infrastructure with firewall configurations and intrusion detection systems to improving application security with secure coding practices and vulnerability management, as well as protecting data with encryption, data loss prevention, and secure disposal methods.

The vulnerability disclosure program operated by CERT-In allows security researchers to report vulnerabilities in Indian organizations, including fintech companies. This program assists in discovering and eliminating security flaws before malevolent actors take advantage of them. CERT-In provides technical details about vulnerabilities and their potential impact, develops profiles for inclusion in the National Vulnerability Database, and issues advisories to the fintech sector about specific security best practices and emerging threats.

5.5. Other Relevant Regulations and Guidelines

Several other regulatory frameworks and guidelines impact cybersecurity practices in Indian fintech companies. The Information Technology Act, 2000, and its amendments provide the legal foundation for cybersecurity in India. Section 43A of the Act establishes compensation for failure to protect data, making companies liable for inadequate security practices resulting in data breaches. Section 69 provides powers for interception, monitoring, and data decryption for national security purposes, while Section 70 designates specific computer systems as protected systems with enhanced security requirements.

Though still in development, India's National Cyber Security Strategy outlines the government's approach to cybersecurity across sectors. For fintech, the strategy emphasizes critical information infrastructure protection, public-private partnerships, and capacity building. The strategy recognizes financial systems as critical infrastructure and requires enhanced protection, including regular security audits and compliance monitoring.

Sector-specific regulators have issued cybersecurity guidelines for fintech companies operating in their domains. The Insurance Regulatory and Development Authority (IRDAI) has issued guidelines for insurance companies and Insurtech firms on cybersecurity and data protection, focusing on governance requirements, risk assessment and management frameworks, security controls for systems and data, incident response and reporting procedures, and business continuity and disaster recovery requirements.

The Pension Fund Regulatory and Development Authority (PFRDA) has cybersecurity requirements for pension fund intermediaries, including fintech platforms, covering security standards for pension transaction processing, data protection requirements for pension account information, access controls and authentication mechanisms, audit and compliance requirements, and business continuity arrangements. The Ministry of Electronics and Information Technology (MeitY) provides digital payment security and authentication guidelines, including security standards for digital payment applications, authentication requirements for payment transactions, and security testing and certification requirements.

The discussion interprets the results in light of the research questions and prior literature, addresses limitations honestly, and avoids overstating causal claims beyond what the design supports.

6. Synthesized Framework for Analyzing Cybersecurity Challenges

Table 4. Synthesized Framework for analyzing Cybersecurity Challenges.

Challenge Category	Key Issues	Regulatory Implications	Mitigation Strategies
Technological Vulnerabilities	Application security flaws, infrastructure misconfigurations, API vulnerabilities, and emerging tech risks	Systemic risk, consumer protection, and regulatory compliance	Secure coding, regular testing, patch management, and emerging tech guidelines
Data Privacy Concerns	Consent management, data localization, cross-border transfers, breach notification	DPDP Act compliance, CERT-In reporting, customer trust	Granular consent, data minimization, breach notification, privacy by design
Operational Challenges	Resource constraints, scalability issues, security culture, and regulatory complexity	Proportional regulation, innovation-supportive frameworks	Risk-based supervision, capacity building, regulatory sandboxes, and harmonized standards

Note: Proposed by the authors.

To address the cybersecurity challenges facing Indian fintech start-ups through a regulatory lens, this employs a synthesized framework that organizes cybersecurity challenges into three broad categories: technological vulnerabilities, data privacy concerns, and operational challenges unique to start-ups. This framework builds on the regulatory approaches outlined in the previous section and provides a structured methodology for analysing the complex interplay between different types of risks and regulatory responses.

6.1. Technological Vulnerabilities

Technological vulnerabilities refer to weaknesses in the systems, applications, and infrastructure fintech companies use to deliver their services. Malicious actors can exploit these vulnerabilities to compromise systems, steal data, or disrupt services. From a regulatory perspective, addressing technological vulnerabilities is fundamental to ensuring the security and resilience of fintech platforms.

Applications are particularly prone to security vulnerabilities, largely due to rapid development cycles where security is often deprioritized. Common issues include injection flaws, such as SQL and command injection, which enable attackers to execute unauthorized commands or access sensitive data. Authentication and session management weaknesses, such as broken authentication or session fixation, can allow unauthorized entry. Insecure direct object references arise when applications grant access to objects based on user-supplied input, enabling attackers to bypass authorization controls. Additionally, security misconfigurations, including default accounts, unnecessary services, verbose error messages, and outdated software, create exploitable gaps that provide attackers with critical information or entry points.

Infrastructure security vulnerabilities in the systems supporting fintech platforms, including servers, networks, and cloud environments, also include Unpatched systems are vulnerable to known exploits due to delayed application of security patches, leaving systems vulnerable to known exploits, as highlighted by RBI's (2021) Cybersecurity Master Direction, requiring vulnerability assessments and patch management. Weak network security, including inadequate network segmentation, firewall configurations, or intrusion detection/prevention capabilities, allows attackers to move laterally within networks once they gain initial access. Insecure cloud configurations, such as publicly accessible storage buckets, overly permissive IAM roles, and unencrypted data in cloud environments, expose data or systems to unauthorized access. Inadequate data encryption at rest or in transit makes sensitive information vulnerable to interception or theft.

API vulnerabilities have become increasingly significant as fintech platforms rely on APIs for integration and service delivery. Broken authentication in APIs allows unauthorized access, while broken authorization permits users to access data or functions beyond their privileges. Excessive data exposure happens when APIs return more data than is required, possibly exposing confidential information through authorized requests, as demonstrated by the MobiKwik 2021 data breach, in which sensitive KYC data was exposed owing to an API vulnerability. The lack of rate restriction allows brute force assaults or denial of service. These vulnerabilities are particularly concerning as APIs often serve as the connective tissue between different services in the fintech ecosystem.

Emerging technology vulnerabilities associated with artificial intelligence, blockchain, and IoT devices introduce new risks. AI/ML vulnerabilities include adversarial attacks that trick machine learning models into making incorrect predictions or extracting sensitive training data. Blockchain vulnerabilities include smart contract flaws, private key management issues, and consensus mechanism weaknesses. IoT security challenges include insecure authentication, weak encryption, and inadequate update mechanisms for connected devices such as point-of-sale terminals and biometric authentication systems.

6.2. Data Privacy Concerns

Data privacy concerns are a major cybersecurity challenge for fintech, focusing on the compliant collection, processing, storage, and sharing of sensitive personal and financial data. Key issues include consent management, which requires clear, jargon-free explanations of data practices and options for granular

consent under the DPDP Act (2023). Maintaining accurate consent records for audits, especially at scale, poses technical challenges.

Data localization regulations compel certain data to be stored in India, creating technical and organizational hurdles, particularly for start-ups with limited resources. Implementing localization while ensuring global service continuity adds complexity, exemplified by Paytm Payments Bank's RBI ban in 2022 for non-compliance with KYC and data storage rules.

Cross-border data transfers complicate compliance for fintech's with international operations. Transfers to countries with adequate protection must assess foreign jurisdictions' frameworks, while standard contractual clauses for other transfers require specific commitments. Binding corporate rules must be approved by data protection authorities.

Effective data breach management is crucial for compliance and customer trust, involving prompt detection, impact assessment, and adherence to reporting timelines. The DPDP Act (2023) mandates reporting to the Data Protection Board and affected individuals, while CERT-In requires rapid notification of cybersecurity incidents within six hours.

6.3. Operational Challenges Unique to Start-ups

Operational challenges represent the third dimension of cybersecurity risks, particularly affecting fintech start-ups due to limited resources, rapid growth, and evolving business models. Financial, technical, and human resource constraints often limit investments in cybersecurity, while rapid scaling, architectural changes, and increasing third-party integrations expand the attack surface and create new security challenges. Building a strong security culture is further constrained by limited cybersecurity awareness and the prioritization of growth over security. In addition, navigating overlapping regulatory requirements from the RBI, SEBI, IRDAI, and CERT-In increases compliance complexity, while evolving regulations and limited compliance capacity place additional burdens on start-ups. Although initiatives such as the RBI's Regulatory Sandbox promote innovation, greater adoption of proportional, risk-based regulatory approaches is needed to balance compliance and innovation.

7. Evaluating the Effectiveness of India's Cybersecurity Frameworks

India's regulatory frameworks provide a strong foundation for addressing cybersecurity in fintech, but their effectiveness is uneven. RBI's Master Directions and Digital Lending Guidelines remain the most impactful in fostering systemic resilience and consumer protection, while SEBI's Cyber Resilience Framework offers technical depth for capital market players. However, significant gaps persist in areas such as AI-driven fraud, blockchain vulnerabilities, and cross-border data management, alongside overlapping mandates that create compliance complexity. For start-ups, the burden of audits, localization requirements, and fragmented oversight often translates into high costs and slower innovation, even as regulatory sandboxes offer limited relief. The way forward lies in harmonizing oversight and adopting proportional, risk-based frameworks that safeguard financial stability while enabling innovation. In India's rapidly evolving fintech ecosystem, the need for adaptive and unified cybersecurity governance is more urgent than ever.

8. Sector-Specific Risks and Regulatory Responses

The fintech ecosystem in India encompasses diverse sectors, each with unique cybersecurity risks and corresponding regulatory responses. This section examines these sector-specific challenges through a

regulatory lens, highlighting how regulators address risks in different fintech segments and identify areas where current approaches may require enhancement.

Table 5. Sector-Specific Risks and Regulatory Responses.

Fintech Sector	Key Cybersecurity Risks	Primary Regulator	Key Regulatory Responses
Digital Payments	Transaction interception, API vulnerabilities, phishing, DDoS attacks	RBI/NPCI	Tokenization, end-to-end encryption, PCI-DSS, and UPI security protocols
Digital Lending	Identity theft, synthetic fraud, data privacy breaches, and algorithmic manipulation	RBI	Digital Lending Norms (2022), KYC/AML, consent management
Wealth Management	Unauthorized trading, portfolio manipulation, account takeover, insider threats	SEBI	Cyber Resilience Framework, algorithm validation, segregation of client funds
Insurtech	Health data breaches, claims fraud, and third-party integration risks	IRDAI	Data protection guidelines, claims processing security, and business continuity requirements
Blockchain/Crypto	Private key theft, brilliant contract exploits, exchange hacks, and regulatory uncertainty	RBI/SEBI/GOI	PMLA extension to VDAs, 30% VDA tax, sandbox testing

Note: Compiled by authors from various sources.

8.1. Digital Payment Systems

Digital payment systems represent a mature segment of India's fintech ecosystem, with UPI, mobile wallets, and payment gateways processing billions of transactions monthly. This scale brings specific cybersecurity challenges, including transaction interception and manipulation through man-in-the-middle attacks and transaction replay; authentication bypass vulnerabilities enabling unauthorized transactions; system availability risks from DDoS attacks; fraudulent apps and websites mimicking legitimate platforms; and API vulnerabilities exposing sensitive transaction data or enabling unauthorized transactions. Regulatory responses include the RBI's payment security guidelines mandating two-factor authentication, end-to-end encryption, tokenization standards, and regular security audits; the NPCI security framework with certification requirements, technical standards, fraud monitoring, and incident response procedures; the tokenization framework enhancing security by replacing card details with unique tokens; and payment aggregator guidelines requiring security certifications, vulnerability assessments, incident reporting, and customer data protection measures.

8.2. Lending FinTechs

Digital lending platforms have transformed credit access in India, particularly for underserved segments, by leveraging alternative data sources and AI algorithms for credit assessment. This segment introduces unique cybersecurity risks related to vast amounts of sensitive personal and financial data processing, advanced credit scoring technologies, and digital onboarding processes that create new attack vectors. Key risks include data privacy concerns from extensive personal information collection, algorithmic manipulation of AI credit underwriting systems, identity fraud through synthetic identities and forged documents, third-party data risks from multiple integrations, and unauthorized loan disbursement vulnerabilities in loan management systems. Regulatory responses include the RBI's comprehensive digital lending guidelines (2022) addressing cybersecurity through transparent disclosure requirements, prohibitions on unauthorized data access, and standardized grievance redressal mechanisms; the Fair Practices Code for lenders ensuring transparent communication and responsible lending practices; data localization requirements enhancing security by keeping sensitive borrower information within Indian jurisdiction; and Credit Information Companies

regulations requiring proper authentication, secure data handling, and consent management for credit information access [29].

8.3. Wealth Management and Investment Platforms

Wealth management and investment platforms, including robo-advisors and discount brokerage firms, have democratized access to investment products in India while handling sensitive financial information and executing trades, making them attractive cyber-attack targets. The sector faces specific cybersecurity risks, including unauthorized trading, portfolio data manipulation, market data integrity compromises, account takeover weaknesses, and insider threats from privileged employees. Regulatory responses include SEBI's Cyber Security and Cyber Resilience Framework with governance requirements, risk assessments, access controls, vulnerability management, and incident response procedures; stock broker guidelines mandating CERT-In empanelled audits; robo-advisory regulations ensuring algorithm validation and data protection; portfolio management services meeting SEBI registration and disclosure requirements; and execution-only platforms complying with new guidelines for clear agent roles and investor rights.

8.4. Insurtech

Insurtech platforms have transformed India's insurance sector by digitizing purchases, processing claims, and handling sensitive personal and health information requiring enhanced privacy protection. This sector faces unique cybersecurity challenges, including health data privacy risks, claims fraud vulnerabilities, underwriting data security concerns, and third-party integration risks due to connections with healthcare providers. Regulatory responses include IRDAI's cybersecurity guidelines covering governance, risk assessment, security controls, and incident response; data protection guidelines for privacy management; a regulatory sandbox for controlled innovation testing; and digital insurance guidelines for secure onboarding, authentication, and data protection [14].

8.5. Blockchain and Cryptocurrency Platforms

Blockchain and cryptocurrency platforms represent a rapidly growing segment of India's fintech ecosystem, facing unique cybersecurity challenges due to blockchain's decentralized nature and the high value of digital assets. Key risks include private key management vulnerabilities, where compromised keys lead to irreversible losses; smart contract vulnerabilities that are immutable once deployed; exchange breaches that have resulted in millions globally; and sophisticated phishing attacks exploiting the irreversible nature of transactions. Regulatory uncertainty further complicates security efforts as platforms navigate evolving requirements. Regulatory responses are emerging through the Finance Act 2022, recognizing VDAs with tax implications, extending PMLA requirements to crypto service providers, developing security standards for digital asset storage, and utilizing regulatory sandboxes for controlled testing of blockchain innovations with appropriate security oversight [30].

9. Challenges in Regulatory Oversight

Despite the comprehensive regulatory frameworks and mechanisms discussed in previous sections, regulatory oversight of cybersecurity in India's fintech sector faces numerous challenges. These challenges stem from the rapidly evolving nature of technology, start-ups' unique characteristics, and the regulatory landscape's complexities. This section thoroughly examines these challenges, highlighting their implications for effective cybersecurity governance.

Table 6. Challenges in Regulatory Oversight.

Challenge Category	Specific Issues	Root Causes	Impact on Fintech Ecosystem
Fragmented Landscape	Overlapping jurisdictions (RBI/SEBI/IRDAI); inconsistent definitions; coordination gaps	Multi-regulator model; siloed operations; lack of unified framework	Regulatory arbitrage; compliance burdens; inconsistent security standards; delayed incident response
Regulatory Gaps	Emerging tech (AI/blockchain/IoT); start-up scalability; cross-border data flows	Rapid innovation; resource constraints; jurisdictional limitations	Unaddressed vulnerabilities; disproportionate compliance costs; enforcement challenges for foreign entities
Enforcement Limitations	Technical expertise gaps, resource constraints, detection challenges, and penalty inconsistency	Talent shortage; funding limits; complex systems; lack of harmonized penalty frameworks	Weak supervision; delayed threat response; inconsistent deterrence; reduced trust in regulation
Innovation-Security Tension	Over-prescriptive rules stifling innovation; pace of regulatory change	Risk-averse regulation; slow rulemaking processes; lack of regulatory sandboxes	Reduced competitiveness; delayed product launches; talent migration to unregulated sectors

Note: Proposed by the authors.

9.1. Fragmented Landscape

The fragmented regulatory landscape creates significant challenges through overlapping jurisdictions and inconsistent definitions across multiple regulatory bodies, including RBI, SEBI, and IRDAI. While providing comprehensive coverage, this multi-regulator model results in siloed operations and a lack of a unified framework. The root causes stem from India's approach to fintech regulation, where separate authorities oversee different financial sectors without adequate coordination mechanisms. Consequently, this leads to regulatory arbitrage where fintech companies structure operations to fall under the most favorable regulator, creating compliance burdens due to inconsistent security standards, and delayed incident response when cyber incidents span multiple regulatory domains.

9.2. Regulatory Gaps

Emerging technologies such as AI, blockchain, and IoT present regulatory gaps as existing frameworks struggle to address these innovations. Additionally, start-up scalability challenges and cross-border data flows create further regulatory voids. These gaps arise from the rapid pace of technological innovation that outstrips regulatory development, start-up resource constraints, and jurisdictional limitations in enforcing requirements. The impacts include unaddressed vulnerabilities in emerging technologies, disproportionately high compliance costs for start-ups, and enforcement challenges for foreign entities operating in India's fintech market.

9.3. Enforcement Limitations

Enforcement of cybersecurity regulations faces significant limitations due to technical expertise gaps, resource constraints, detection challenges, and penalty inconsistency. These issues stem from a shortage of specialized cybersecurity talent, limited funding for regulatory agencies, the complexity of modern fintech systems, and a lack of harmonized penalty frameworks across regulators. The consequences manifest as weak supervision capabilities, delayed threat response to cyber incidents, inconsistent deterrence against security violations, and reduced trust in regulatory oversight among fintech stakeholders.

9.4. Innovation-Security Tension

The tension between fostering innovation and ensuring security creates regulatory challenges through over-prescriptive rules that stifle innovation and the slow pace of regulatory change. This tension originates from risk-averse regulatory approaches, bureaucratic rulemaking processes, and insufficient regulatory sandbox

mechanisms for testing innovations. The impacts include reduced competitiveness of India's fintech sector globally, delayed product launches that slow market evolution, talent migration to less regulated sectors, and missed opportunities for beneficial fintech innovations that could enhance financial inclusion.

10. Strategic Policy Directions for Fintech Cybersecurity

Following are the strategic policy directions offered for fintech cybersecurity:

10.1. Regulatory Harmonization and Unified Framework

A coordinated regulatory approach is essential to address fragmentation arising from multiple oversight bodies. Establishing a unified national cybersecurity framework that aligns the roles of the Reserve Bank of India, Securities and Exchange Board of India, Insurance Regulatory and Development Authority of India, CERT-In, and the Data Protection Board will streamline compliance, reduce duplication, and strengthen governance consistency across the fintech ecosystem.

10.2. Proportional and Risk-Based Regulation

Given the diversity of fintech start-ups in terms of size and maturity, proportional regulation is necessary. A risk-based framework that tailors cybersecurity requirements to operational scale and risk exposure will reduce compliance burdens on smaller firms while ensuring adequate safeguards and encouraging gradual security enhancements as firms expand.

10.3. Regulatory Sandboxes and Emerging Technology Guidelines

Expanding regulatory sandboxes will enable fintech start-ups to test innovative cybersecurity solutions under supervised environments. In addition, regulators should develop sector-specific guidelines for emerging technologies such as artificial intelligence-driven credit scoring, blockchain-based financial services, and IoT-enabled applications to address unique cybersecurity vulnerabilities.

10.4. Quantum-Ready Security and Future Preparedness

As quantum computing advances, fintech systems must prepare for new security risks. Policymakers should encourage awareness, research, and gradual adoption of post-quantum cryptography standards to ensure long-term resilience and safeguard financial data against future threats.

10.5. Global Benchmarking and International Alignment

Cybersecurity challenges in fintech are global in nature, and benchmarking against leading fintech hubs can enhance resilience. Learning from international frameworks, robust data protection standards, harmonized API security practices, and advanced cyber risk management approaches will help Indian fintech firms strengthen security and facilitate cross-border expansion.

10.6. Collaboration with Global Capability Centres (GCCs)

Global Capability Centres can provide fintech start-ups access to advanced cybersecurity expertise, global regulatory insights, and modern digital infrastructure. Structured collaboration between regulators, start-ups, and GCCs will support capability development, bridge talent gaps, and align domestic practices with international standards.

10.7. Capacity Building and Structured Collaboration

Addressing cybersecurity talent shortages requires sustained capacity-building initiatives. Government–industry–academia partnerships, professional training, certifications, and awareness programs tailored to fintech start-ups can build a security-conscious ecosystem. Collaborative platforms for sharing threat intelligence and best practices, supported by government incentives, will further strengthen collective resilience.

11. Conclusion

India's fintech ecosystem has rapidly transformed financial services by enhancing innovation, efficiency, and financial inclusion, yet this growth has simultaneously exposed the sector to complex and evolving cybersecurity risks. Fintech start-ups, in particular, face vulnerabilities arising from technological dependencies, data privacy concerns, and limited resources, further intensified by fragmented regulatory oversight and overlapping compliance requirements. While existing frameworks introduced by multiple regulators provide a strong foundation, gaps remain in harmonizing governance, addressing emerging technologies, and reducing disproportionate compliance burdens. Strengthening regulatory coordination, adopting proportional and risk-based approaches, expanding regulatory sandboxes, promoting global benchmarking, and fostering collaboration with Global Capability Centres and academia–industry partnerships are essential to build systemic resilience. Preparing for quantum-era threats and embedding privacy-by-design and security-by-design principles will further enhance long-term sustainability. In a rapidly evolving digital financial landscape where cyber threats continue to grow in scale and sophistication, the need for adaptive, coordinated, and unified cybersecurity governance is more urgent than ever before.

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Author Contributions

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References

[1] Anagnostopoulos, I. (2018). Fintech and Regtech: Impact on regulators and banks. Journal of Economics and Business, 100, 7–25.

[2] Arner, D. W., Barberis, J. N., & Buckley, R. P. (2015). The Evolution of Fintech: A New Post-Crisis Paradigm? SSRN Electronic Journal.

[3] Boston Consulting Group. 2023. India's Fintech Market Growth and Global Positioning. Boston: Boston Consulting Group.

[4] Chen, M. A., Wu, Q., & Yang, B. (2019). How Valuable Is FinTech Innovation? The Review of Financial Studies, 32(5), 2062–2106.

[5] Financial Stability Board (FSB). 2021. Enhancing Cyber Resilience in the Financial Sector: FSB Cybersecurity Standards. Basel: Financial Stability Board.

[6] General Fintech Regulatory Literature. n.d. "Studies on International Regulatory Sandboxes and GDPR-Equivalent Protections." Journal of Fintech Regulation and Policy Studies.

[7] Gimpel, H., Rau, D., & Röglinger, M. (2018). Understanding FinTech start-ups – a taxonomy of consumer-oriented service offerings. Electronic Markets, 28(3), 245–264.

[8] Haddad, C., & Hornuf, L. (2019). The emergence of the global fintech market: Economic and technological determinants. Small Business Economics, 53(1), 81–105.

[9] IBM Security. 2023. Cost of a Data Breach Report. Armonk, NY: IBM.

[10] India Brand Equity Foundation. 2023. India Fintech Report. New Delhi: IBEF.

[11] Indian Computer Emergency Response Team. 2021. Annual Report 2020–21. New Delhi: CERT-In.

[12] Indian Computer Emergency Response Team. 2022. Directions on Cyber Incident Reporting. New Delhi: CERT-In.

[13] Inc42 Media. 2020. The State of Indian Fintech Report. Bangalore: Inc42.

[14] Insurance Regulatory and Development Authority of India. 2022. Guidelines on Cyber Security for the Insurance Industry. Hyderabad: IRDAI.

[15] Lee, I., & Shin, Y. J. (2018). Fintech: Ecosystem, business models, investment decisions, and challenges. Business Horizons, 61(1), 35–46.

[16] Milian, Ezgi Z., Stephanie Moulton, and Shalini Singh. 2022. "Cybersecurity in the Fintech Sector: A Systematic Literature Review." Journal of Financial Regulation and Compliance 31 (3): 321–36.

[17] Ministry of Electronics and Information Technology. 2023. Digital Personal Data Protection Act, 2023. New Delhi: MeitY.

[18] Nahar, Jyoti, and Rakesh Bhat. 2022. "Regulatory Challenges for Fintech in Emerging Markets: Evidence from India." Journal of Financial Economic Policy 14 (3): 412–35.

[19] Nahar, Jyoti, and Rakesh Bhat. 2023. "Regulatory Sandboxes as a Tool for Fintech Innovation: Evidence from India." Journal of Financial Economic Policy 15 (2): 245–67.

[20] National Association of Software and Service Companies. 2023. Indian Fintech Landscape. New Delhi: NASSCOM.

[21] National Cyber Security Coordinator. 2023. Annual Report on Cybersecurity Threats. New Delhi: NCSC.

[22] National Payments Corporation of India. 2019. Unified Payments Interface: Product Overview. Mumbai: NPCI.

[23] National Payments Corporation of India. 2023. UPI Performance Statistics. Mumbai: NPCI.

[24] Philippon, Thomas. 2020. "The Fintech Opportunity." NBER Working Paper No. 27460. Cambridge, MA: National Bureau of Economic Research.

[25] PricewaterhouseCoopers. 2023. India Fintech Trends Report. Mumbai: PwC.

[26] Reserve Bank of India. 2019. Framework for Regulatory Sandbox. Mumbai: RBI.

[27] Reserve Bank of India. 2021. Master Direction on Cyber Security (Updated). Mumbai: RBI.

[28] Reserve Bank of India. 2022. Cloud Computing Guidelines. Mumbai: RBI.

[29] Reserve Bank of India. 2022. Guidelines on Digital Lending. Mumbai: RBI.

[30] Reserve Bank of India. 2023. Financial Stability Report. Mumbai: RBI.

[31] Reserve Bank of India (RBI), and Securities and Exchange Board of India (SEBI). 2022. Cybersecurity and Cloud Computing Frameworks for Financial Institutions. Mumbai: RBI and SEBI.

[32] Securities and Exchange Board of India. 2015. Cyber Security and Cyber Resilience Framework. Mumbai: SEBI.

[33] Securities and Exchange Board of India. 2021. Cyber Security and Cyber Resilience Framework (Updated). Mumbai: SEBI.

[34] Zetzsche, D. A., Buckley, R. P., & Arner, D. W. (2021). Regulating Libra. Oxford Journal of Legal Studies, 41(1), 80–113.