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Too Connected to Fail? Network Evidence on Fintech's Systemic Risk and Financial Stability

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Abstract
The increasing integration of financial technology (fintech) into mainstream financial systems offers speed, efficiency, and expanded access, but also heightens systemic vulnerabilities. This study applies network analysis to investigate how fintech adoption—captured through digital lending, payment volumes, funding flows, and associated technological dependencies—interacts with systemic risk drivers such as cybercrime, bank fraud, market volatility, macroeconomic uncertainty, and cryptocurrency regulation. Using data from 2014–2024 on India's fintech ecosystem, degree and betweenness centrality metrics reveal that variables including the UCRY Policy Index, India VIX, and cybercrime rates occupy critical positions within the network, acting as hubs and bridges for risk transmission. The findings highlight the "Too Connected to Fail" nature of certain fintech segments, where disruptions in high-centrality nodes can cascade across markets and institutions. To mitigate these risks, the study recommends adaptive regulatory frameworks that address fintech-specific vulnerabilities, strengthening cybersecurity protocols modelled on best practices such as Singapore's MAS Cyber Hygiene Guidelines, and implementing market safeguards like liquidity backstops and transaction halts during periods of extreme volatility. The analysis also demonstrates how divergent cryptocurrency regulatory regimes—from Japan's licensing approach to China's bans—reshape network structures and influence stability. While the results are most applicable to emerging market contexts, the framework and strategic recommendations are relevant across jurisdictions. The study advances the understanding of fintech-related systemic risk and offers actionable guidance for policymakers, regulators, and industry stakeholders seeking to enhance financial stability in the digital era.
Keywords: Network. Systemic Risk, Financial Stability

Introduction

The global financial sector is undergoing a profound transformation driven by the rapid rise of financial technology (fintech) (IMF, 2022). Offering speed, efficiency, and customer-centric innovation, fintech services such as digital lending, payments, robo-advisors, and cryptocurrencies are altering traditional market structures and enabling greater financial inclusion (Feyen et al., 2021). However, these benefits are accompanied by growing systemic

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risks. The ascent of fintech is characterized by an exponential surge in digital transactions, digital lending platforms, robo-advisors, and cryptocurrencies (Jain, 2023; Cornelli, et al., 2023).

The concentration of technology providers, reliance on shared cloud and data infrastructures, and the high degree of interconnectivity among financial actors amplify vulnerabilities (Buckley et al., 2019). This interconnectedness can trigger "Too Big to Fail" and "Too Connected to Fail" scenarios, where shocks in one segment of the financial system rapidly propagate to others (Li et al., 2020).

Regulatory responses, especially in cryptocurrency markets, vary significantly across jurisdictions, influencing systemic risk in different ways. For example, Japan's licensing framework for exchanges promotes transparency, while China's outright ban seeks to remove the risks associated with crypto markets entirely (Lucey et al., 2022). Such divergences in policy approaches reshape network structures and impact overall financial stability. Given these dynamics, tools capable of mapping and quantifying interdependencies are essential. Network analysis provides such a lens, enabling the identification of critical nodes, pathways for contagion, and the implications of regulatory, technological, and market changes for systemic resilience (Jackson & Pernice, 2019).

As fintech innovations permeate various sectors of the economy, the interconnectivity and interdependence of financial markets and banking systems amplify the magnitude of systemic risks, necessitating a nuanced understanding and proactive management approach. Also, the interconnectedness of the fintech ecosystem may amplify these risks and significantly affect financial stability and national security. FinTech operates in a dynamic regulatory environment, often characterized by evolving rules and standards (Muganyi, 2022). The transformative potential of fintech is accompanied by a myriad of challenges and vulnerabilities that have the potential to ripple through entire financial systems, affecting stakeholders at every level.

While studies on systemic risk are extensive following the aftermath of the financial crisis (Lavinia, 2020), there is limited literature exploring systemic risk by adopting fintech innovation. Previously, limited studies have delved into the correlation between fintech and systemic risk, yielding inconclusive findings (Adrian, 2016). The risk is greater during periods of high volatility or large price swings than in normal market conditions. High levels of Economic Policy Uncertainty (EPU) lead to increased systemic risk in fintech, especially in the long run (Aktham, 2023).

This study investigates whether the rapid growth of fintech has created a "Too Connected to Fail" environment, where the benefits of innovation are counterbalanced by heightened systemic fragility. Using a network analysis framework, the research examines how expanding digital lending, payment systems, and fintech funding flows intersect with critical risk drivers such as cybercrime, bank fraud, economic policy uncertainty (India NBPU Index), cryptocurrency regulation (UCRY Policy Index), and price volatility (UCRY Price Index). The analysis reveals that fintech platforms are not merely individual actors but highly interconnected nodes within a dense web of financial and technological relationships. In such a network, disruptions in one segment—whether triggered by a regulatory shift, cyber incident, or market shock—can propagate rapidly, amplifying overall systemic risk as captured by the India VIX. By mapping these interdependencies across multiple fintech segments, the study highlights how interlinked

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vulnerabilities increase the likelihood of cascade failures and contagion effects, posing significant challenges for financial stability.

Methodology

The dataset spans 2014–2024, drawing from multiple sources: cybercrime and bank fraud statistics from NCRB (2024), fintech adoption indicators from Statista (2024), market volatility data from NSE India, and policy indices from Lucey et al. (2022). Variables include fintech adoption metrics (digital lending value, payment volumes, funding value of fintech and lending-tech start-ups), systemic risk measures (India VIX), macroeconomic uncertainty (India NBPU Index), cybercrime rates, bank fraud cases, and cryptocurrency regulation indicators (UCRY Policy and Price Index).

Following (Boccaletti, 2006), the financial system is modelled as a network G = (V, E), where V represents variables and E the relationships between them. Degree centrality measures the number of direct connections a variable has, while betweenness centrality assesses its role in linking other variables. This approach reveals how shocks—such as a change in crypto regulation or a cyberattack—could cascade through the network, amplifying systemic risk (Adrian & Brunner Meier, 2016). Network analysis sheds light on systemic risk, revealing unique features of financial markets, such as externalities and inefficiencies (Jackson, 2019). Fintech contagion is unique for its exposure to diverse organizations like large banks, tech companies, regulators, and the general public, fostering complex dynamic relationships leading to cascading defaults. Given the variety of exposure and connections, there are several types of contagion, including more straightforward and more complicated contagions and financial technology contagions. Since the fintech ecosystem is diverse and the frequency of extreme occurrences varies depending on the ecosystem, regulators must comprehend systemic risk, cyber security threat, and counterparty to counterparty.

Fintech systemic risks are similar to pandemics and earthquakes; the chance of occurrence is less, but the damage is more significant. With network analysis, these endogenous structures can be captured, and systemic risk can be sensitized. Hence, network analysis has been crucial for understanding the interconnectedness and vulnerabilities within complex systems. Typically, systemic risk analysis begins with representing the system as a graph, where G=(V,E), with V representing the set of nodes and E the set of edges representing relationships or dependencies between them. Node degrees, denoted ki, and centrality measures such as degree centrality ($CD_{(i)}$) and betweenness centrality ($CB_{(i)}$)measures reveal the importance of individual nodes in the network and are given by

$$CD_{(i)} = k_i \,/N - 1$$

$$CB_{(i)} = \sum_{s \neq i \neq t} \frac{\sigma_{st}(i)}{\sigma_{st}}$$

Network analysis facilitates the development of robust regulations and risk mitigation strategies by assessing systems' stability, vulnerability, and resilience amid fintech adoption and systemic risk. Descriptive statistics and correlation are enunciated in Table 1 and Graph 1. This study

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includes the time frame from 2014 to 2014; the data source is mentioned in the Appendix. Correlation analysis indicates that digital lending, payment, bank fraud cases and cybercrime are highly positively related.

Results

Degree centrality measures in Table. 1 enunciate how well-connected each variable is within the network, while betweenness centrality shows the importance of certain variables in facilitating communication or interaction between other variables. These centrality measures provide valuable insights into variables' structure and dynamics, help identify critical variables, and understand their impact on the overall system.

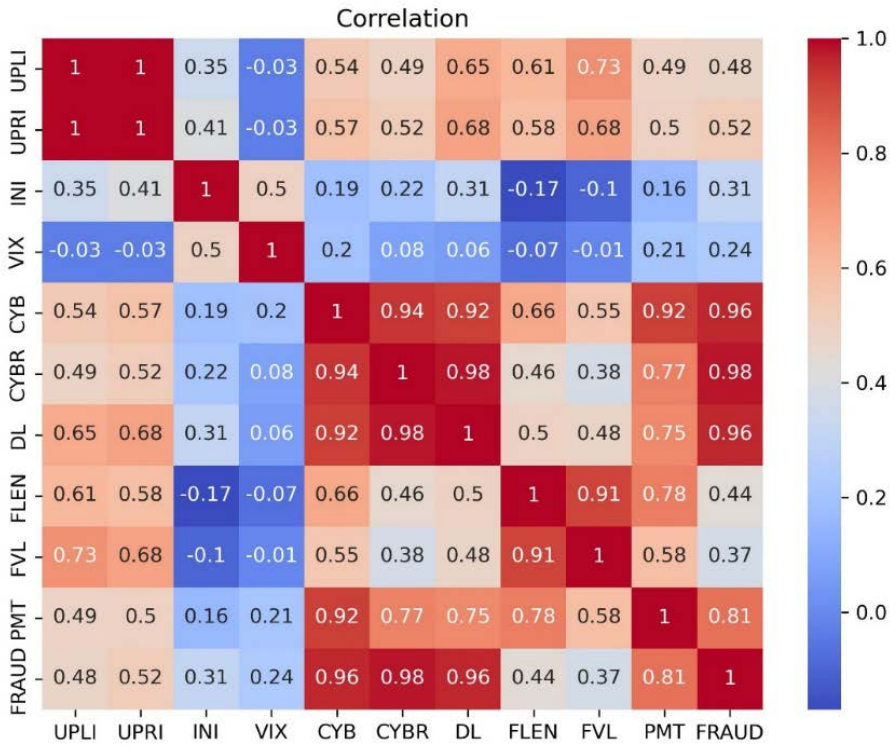

Figure 1: Correlation

Source: Authors own Calculation

Table 1: Descriptive Statistics

Variables	Mean	SE	Median	SD	Min	Max
UPLI - UCRY Policy Index	101.64	1.05	100.20	3.32	99.42	109.34
UPRI - UCRY Price Index	101.83	1.17	100.21	3.71	99.47	110.80
INI - India NBPU Index	70.42	9.11	65.90	28.82	40.59	120.70
VIX - India VIX	21.66	4.86	16.88	15.36	12.42	64.41
CYB - Cybercrime	10.32	0.26	10.46	0.82	9.17	11.57
CYBR - Rate of Cybercrime	2.96	0.69	2.68	2.18	0.76	7.69
DL - Digital lending	131.50	34.93	92.50	110.45	23.00	350.00

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FLEN - Funding value of lending tech	0.65	0.13	0.66	0.41	0.08	1.46
FVL - Funding value of fintech	2.71	0.71	2.10	2.25	0.20	8.00
PMT – Payment	10.92	2.04	13.85	6.46	0	16.61
FRAUD – Bank Fraud Cases	8.79	0.12	8.76	0.37	8.37	9.51

Correlation analysis (Figure 1) shows strong positive relationships between fintech adoption (digital lending, payments, funding values) and systemic risk-related indicators, including cybercrime rates and policy uncertainty (Aktham, 2023).

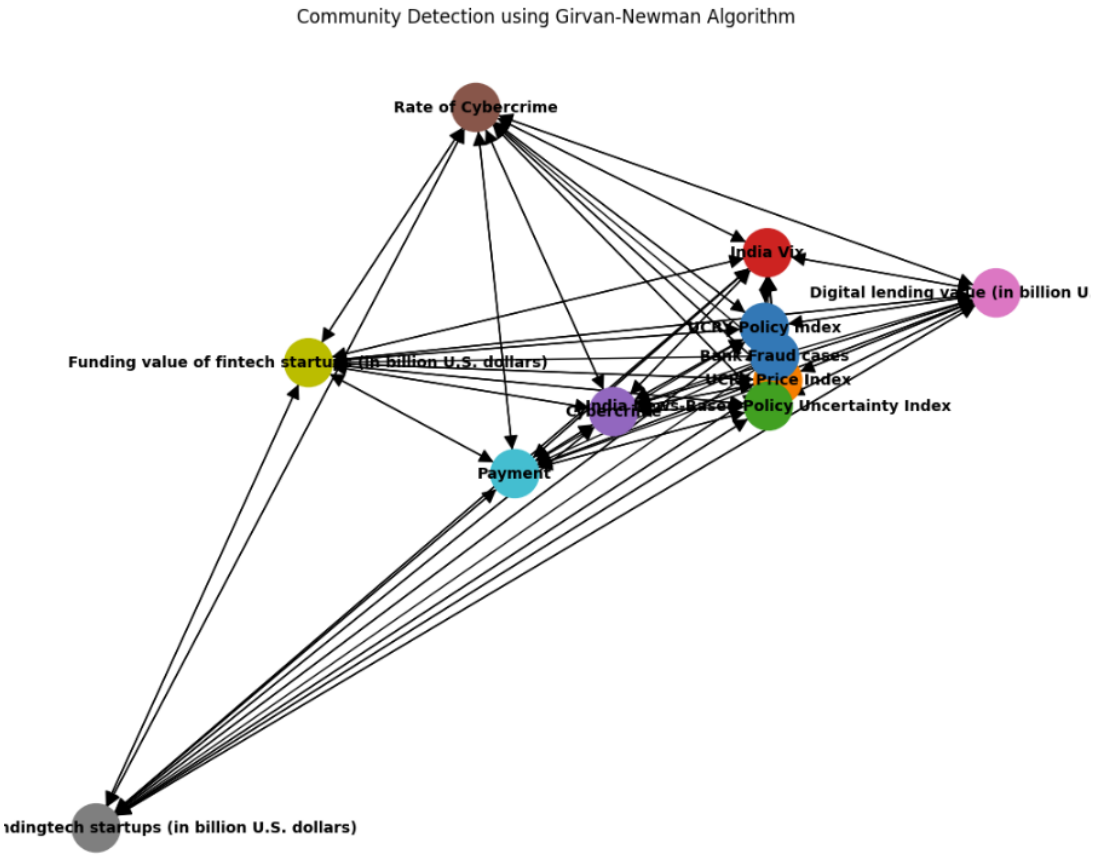

Figure 2: Network Analysis Results
Source: Authors own Calculation

Table 2: Network Performance Metrics

Variables	Degree Centrality	Betweenness Centrality
UCRY Policy Index	1.8	0.19
UCRY Price Index	1.8	0.0
India News-Based Policy Uncertainty Index	1.9	0.09
India VIX	1.9	0.05

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Cybercrime	1.9	0
Rate of Cybercrime	1.9	0.13
Digital lending value	1.9	0.0
Funding value of lending tech start-ups	1.9	0.16
Funding value of fintech startups	1.9	0.0
Payment	1.7	0.0
Bank Fraud cases	1.0	0.0

Source: Authors own Calculation

Variables such as 'The UCRY Policy Index' and 'UCRY Price Index capturing crypto currency uncertainty, 'The India News-Based Policy Uncertainty Index,' 'India VIX' representing financial market volatility and systemic risk, 'Cybercrime,' 'Rate of Cybercrime,' 'Digital lending value,' 'Funding value of lending-tech start-ups', and 'Funding value of fintech start-ups show high degree centrality indicating its prominence within the network. Particularly, the 'UCRY Policy Index,' along with the funding value of lending-tech start-ups and the rate of cybercrime, stands out with notably high betweenness centrality. These variables serve as bridges or intermediaries, potentially influencing information flow and relationships among other variables.

The research findings shed light on the intricate network of relationships, unveiling key insights that have significant implications across multiple domains. Centrality measures highlight the crucial role of variables such as the UCRY Policy Index, India VIX, Cybercrime, India news-based policy uncertainty index, and Funding value of lending-tech start-ups in shaping network dynamics. Conversely, payment and bank fraud cases exhibit lower centrality and are less interconnected with other variables. A lower reactivity between fintech credit and monetary policy shocks (Cornelli, et al., 2023). Although it is not an equitable comparison, there is evident interaction between fintech lending and news-based monetary policy uncertainties in this research. These findings offer valuable guidance for policymakers, enabling them to craft more effective policies that address the interconnectedness of different factors. This indicates that high-centrality variables—including digital lending value, funding flows to fintech start-ups, cybercrime rates, and systemic risk indicators such as the India VIX—play a pivotal role in determining the resilience or fragility of the financial ecosystem. Their network prominence suggests two contrasting implications. First, from an investment perspective, these nodes represent sectors where capital allocation can generate significant market impact, particularly in promoting financial inclusion and technological advancement (Feyen et al., 2021). Second, their high centrality also implies a heightened potential for shock transmission. Disruptions in these areas—whether from a cyberattack, funding contraction, or regulatory change—can rapidly cascade across interconnected platforms, amplifying systemic risk (Boccaletti et al., 2006; Li et al., 2020).

This “Too Connected to Fail” characteristic highlights the importance of proactive governance. Adaptive regulatory frameworks that address fintech-specific vulnerabilities (Buckley et al., 2019), robust cybersecurity protocols modelled on global best practices such as Singapore’s MAS Cyber Hygiene Guidelines ((MAS), Monetary Authority of Singapore, 2019), and market safeguards like liquidity backstops and circuit breakers (Panetta, 2018) can mitigate contagion

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effects. This also reinforces the need for cross-disciplinary collaboration. Economists, policymakers, technologists, and cybersecurity experts must jointly address the socio-economic complexities of fintech risk (Jackson & Pernice, 2019). By quantifying interdependencies and identifying risk transmission pathways, this research advances understanding of how fintech innovation interacts with systemic stability. Ultimately, the findings offer decision-makers actionable insights to foster resilience—ensuring that digital finance can evolve without compromising the integrity of the broader financial system.

Conclusion

This study makes important contributions to the literature on fintech adoption, cybercrime, systemic risk, and network analysis by mapping the complex interdependencies within the digital financial ecosystem. Through the application of network analysis, the research identifies how interconnected variables—such as digital lending, payments, funding flows, cybercrime rates, and bank fraud cases—interact with macroeconomic and cryptocurrency policy uncertainties to shape systemic stability (Boccaletti et al., 2006; Feyen et al., 2021). The findings reveal that certain high-centrality nodes, notably fintech funding and cybercrime, function as critical transmission channels for financial shocks, reflecting a "Too Connected to Fail" structure (Li et al., 2020).

These results have direct implications for risk management. By pinpointing the nodes and pathways most likely to amplify contagion effects, the study provides a foundation for adaptive regulatory frameworks, enhanced cybersecurity protocols, and targeted market safeguards (Buckley et al., 2019; Panetta, 2018). The analysis underscores the value of cross-disciplinary collaboration between economists, policymakers, technologists, and cybersecurity experts to manage emerging threats in fintech networks (Jackson & Pernice, 2019). Ultimately, this research advances both theoretical and practical understanding of fintech-related systemic risk, offering actionable guidance for designing resilient financial systems capable of sustaining innovation without compromising stability.

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Appendix

Variables	Source
UCRY Policy Index	Lucey et al. (2022)
UCRY Price Index	Lucey et al. (2022)
India News-Based Policy Uncertainty Index	Economic Policy Uncertainty Index
India VIX	nseindia.com
Cybercrime	ncrb.gov.in
Rate of Cybercrime	ncrb.gov.in
Digital lending value	statista.com
Funding value of lending tech start-ups	statista.com
Funding value of fintech startups	statista.com
Payment	statista.com
Bank Fraud cases	statista.com

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