MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1s, 2026, Pages: 3552-3558

Digital Infrastructure Readiness and Cash Dependency as Proxies for Blockchain Adoption Potential: A Comparative Analysis of Indian Public Sector Banks (April–September 2025)

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ABSTRACT
Blockchain technology holds significant promise for transforming regulatory compliance processes in India's banking sector. However, the existing literature lacks a data-driven, bank-level analysis of which institutions are realistically positioned to adopt blockchain for compliance purposes. This study proposes two proxy indicators — the Digital Infrastructure Score (DIS) and the Cash Dependency Ratio (CDR) — derived from Reserve Bank of India (RBI) secondary data covering 12 public sector banks across six months (April–September 2025). A Pearson correlation analysis between average DIS and CDR values yields $r = -0.711$ ($p = 0.0095$), confirmed by a Spearman rank correlation ($\rho = -0.699$, $p = 0.011$), establishing a statistically significant negative relationship between digital infrastructure strength and cash dependency. A Composite Blockchain Readiness Index (BRI) is constructed by normalising both metrics, ranking banks on a unified scale. Findings reveal that Central Bank of India, Uco Bank, Bank of Maharashtra, Indian Bank, and Canara Bank are most prepared for blockchain-based regulatory compliance adoption, while Union Bank of India and PNB face the greatest structural barriers. This study contributes a novel, reproducible framework for assessing blockchain adoption readiness using publicly available RBI data, and identifies specific entrepreneurial opportunities in RegTech and compliance automation for each bank segment.

Keywords: Blockchain, Digital Infrastructure Score, Cash Dependency Ratio, Regulatory Compliance, Indian Public Sector Banks, Blockchain Readiness Index, RegTech, FinTech

1. INTRODUCTION

Blockchain technology — a distributed, immutable digital ledger — has attracted widespread attention across the global financial industry as a mechanism for enhancing transparency, security, and operational efficiency. In the context of Indian banking, where regulatory compliance obligations imposed by the Reserve Bank of India (RBI), the Securities and Exchange Board of India (SEBI), and the Financial Intelligence Unit (FIU) demand continuous audit trails, real-time reporting, and robust Know Your Customer (KYC) and Anti-Money Laundering (AML) processes, blockchain offers a structurally superior alternative to existing fragmented, paper-intensive systems.

Despite this potential, blockchain adoption in Indian public sector banks remains nascent. A critical barrier is the absence of a systematic, data-grounded framework for identifying which banks are realistically prepared to integrate blockchain into their compliance infrastructure. Most existing studies address blockchain's theoretical benefits or its regulatory challenges in general terms; few attempt to empirically distinguish between banks that are ready for adoption and those that are not.

This study addresses that gap. Using RBI's publicly available payment system statistics for April through September 2025, the research constructs two bank-level indicators: the Digital Infrastructure Score (DIS), measuring the density of digital payment acceptance infrastructure relative to legacy ATM infrastructure; and the Cash Dependency Ratio (CDR), measuring customer reliance on cash withdrawal relative to digital payment transactions. These two metrics are treated as proxies for a bank's operational readiness for blockchain adoption. The study then conducts a Pearson and Spearman correlation analysis between DIS and CDR, constructs a Composite Blockchain Readiness Index (BRI), classifies banks into four readiness quadrants, and discusses the entrepreneurial and policy implications of each segment.

The remainder of this paper is organised as follows. Section 2 reviews the relevant literature. Section 3 presents the research methodology and conceptual framework. Section 4 reports the data analysis and findings. Section 5 discusses the results in terms of entrepreneurial opportunity and policy challenges. Section 6 concludes.

2. LITERATURE REVIEW

2.1 Blockchain in Banking: Theoretical Foundations: Nakamoto's (2008) foundational articulation of a peer-to-peer electronic cash system established the core architecture of blockchain — a chain of time-stamped, cryptographically linked blocks validated through distributed consensus — as an alternative to centralised trust intermediaries. Viriyasitavat and Hoonsopon (2019) extended this framework to modern business processes, demonstrating that blockchain characteristics such as immutability, transparency, and decentralisation are particularly well-suited to environments requiring verifiable audit trails and multi-party coordination, both of which are central to banking compliance.

Martino (2019) identified the primary challenges and opportunities that blockchain presents to banks, including the need for interoperability with legacy systems, regulatory uncertainty, and the potential for significant cost reduction in cross-border payments and compliance reporting. Rahman et al. (2024), in a systematic review and bibliometric analysis of blockchain in banking, confirmed that regulatory compliance, fraud prevention, and KYC automation are the three most recurrent applications in the literature, underscoring the relevance of the compliance focus adopted by this study.

2.2 Blockchain Adoption in the Indian Context: Gupta and Gupta (2018) provided one of the earliest comprehensive reviews of blockchain applications in the Indian banking sector, concluding that the technology had the potential to make Indian banking more secure, transparent, and cost-effective, while noting that adoption barriers — including unclear regulation and infrastructural heterogeneity — remained significant. Mohite (2018) highlighted the regulatory challenges specific to blockchain adoption in India, particularly the absence of a unified policy framework governing distributed ledger technology in financial services.

Meenakshi and George (2018) argued that blockchain could resolve the absence of a common transaction record across Indian banks, thereby reducing fraud and enabling paper-free operations. Gandhi (2019) proposed a comparative analysis between the existing banking

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1s, 2026, Pages: 3552-3558

system and a blockchain-based alternative, noting that real-world implementation required further empirical testing. Khanna and Haldar (2022), using qualitative research methods, found that blockchain adoption in Indian banking was hampered by a combination of technology uncertainty, regulatory ambiguity, and workforce readiness concerns. Dighe (2021) provided a sector-level implementation overview, while Kajla and Sood (2024), integrating the Technology-Organisation-Environment (TOE) framework with fuzzy AHP, identified digital infrastructure maturity as a primary adoption driver.

2.3 RegTech, KYC, and Compliance Automation: John (2025) and Karadağ et al. (2024) demonstrated the technical feasibility of blockchain-based KYC and access verification systems, showing that permissioned blockchain networks can significantly reduce duplicate KYC efforts across financial institutions while maintaining regulatory compliance. Haidar et al. (2025) examined the impact of blockchain on financial auditing and regulatory compliance in a developing-country banking context, finding that smart contract automation materially reduced compliance processing time and error rates. Kawasmi et al. (2020) proposed a global blockchain adoption model for banking, emphasising that institutional readiness — particularly digital infrastructure — was a necessary precondition for successful deployment.

2.4 Research Gap

The existing literature provides a broad theoretical and qualitative understanding of blockchain's potential in Indian banking and its compliance applications. However, it lacks a specific, data-driven, bank-level analysis that uses publicly available RBI data to empirically assess which Indian public sector banks are positioned for blockchain adoption. No prior study has proposed a composite readiness index derived from digital payment infrastructure and cash dependency metrics, nor has any study conducted a correlation analysis between these proxies to test whether digital infrastructure maturity is systematically associated with reduced cash dependency — a relationship that would validate the use of these metrics as blockchain readiness proxies. This study fills that gap.

3. RESEARCH METHODOLOGY

3.1 Research Design and Data Source: This study adopts a quantitative, secondary-data research design. The data source is the Reserve Bank of India's payment system statistics — specifically, the ATM, Card, Point-of-Sale (PoS), and Acceptance Infrastructure Statistics for the six-month period April to September 2025. These statistics are publicly available on the RBI website and are reported monthly at the bank level. The study covers 12 Indian public sector banks: Bank of Baroda, Bank of India, Bank of Maharashtra, Canara Bank, Central Bank of India, Indian Bank, Indian Overseas Bank, Punjab and Sind Bank (P&S Bank), Punjab National Bank (PNB), State Bank of India (SBI), Uco Bank, and Union Bank of India.

3.2 Proxy Indicators

Two proxy indicators are constructed to measure digital infrastructure readiness and cash dependency respectively. These indicators serve as empirical proxies for a bank's structural readiness to adopt blockchain-based regulatory compliance systems.

Digital Infrastructure Score (DIS): The DIS captures the relative density of modern digital payment acceptance infrastructure — UPI QR codes, Bharat QR codes, Point-of-Sale terminals, and Micro ATMs — against legacy ATM infrastructure (on-site and off-site ATMs). A higher DIS indicates that a bank's acceptance network is more weighted toward digital touchpoints, suggesting greater operational alignment with blockchain-compatible digital systems. The formula is as follows:

$$DIS = (UPI\ QR + Bharat\ QR + PoS + Micro\ ATMs) / (ATMs\ On\text{-}site + ATMs\ Off\text{-}site)$$

Cash Dependency Ratio (CDR): The CDR measures the extent to which customers rely on cash withdrawals relative to digital payment activity — card payments and UPI transactions. A higher CDR indicates that customers conduct proportionally more cash-based transactions, suggesting lower digital transaction maturity and, by extension, a less favourable environment for blockchain-based compliance automation that depends on digital transaction trails.

$$CDR = Cash\ Withdrawal\ Value / (Card\ Payment\ Value + UPI\ Transaction\ Value)$$

3.3 Analytical Methods

Three analytical methods are employed. First, Pearson product-moment correlation is computed between bank-level average DIS and average CDR values across the six-month period to test whether digital infrastructure strength is negatively associated with cash dependency. A Spearman rank correlation is computed as a non-parametric robustness check. Second, a month-wise Pearson correlation is computed for each of the six months to assess the temporal stability of the relationship. Third, a Composite Blockchain Readiness Index (BRI) is derived as follows:

$$BRI = Normalised(DIS) - Normalised(CDR)$$

where normalisation uses min-max scaling across the 12 banks. A positive BRI indicates above-average blockchain readiness; a negative BRI indicates below-average readiness. Banks are additionally classified into four quadrants based on whether their average DIS and CDR are above or below the 12-bank median

4. DATA ANALYSIS AND FINDINGS

4.1 Digital Infrastructure Score — April 2025

Table 1 presents the raw data and computed DIS values for April 2025.

Table 1: Digital Infrastructure Score — April 2025

Bank	PoS	Micro ATMs	Bharat QR	UPI QR	On-site ATMs	Off-site ATMs	DIS
Bank of Baroda	51,874	44,745	24,251	2,573,124	8,652	2,394	243.89
Bank of India	18,476	23,196	0	1,264,361	5,322	2,678	163.25
Bank of Maharashtra	68	6,285	355,014	941,058	2,170	252	537.75
Canara Bank	76,084	8,304	0	3,799,380	7,370	3,658	352.17
Central Bank of India	3,289	2,649	35,673	2,016,531	2,879	1,188	506.06
Indian Bank	19,845	14,744	0	2,916,477	4,688	616	556.39
Indian Overseas Bank	0	10,192	0	462,806	2,762	734	135.30
P&S Bank	1,004	1,740	1,150	185,031	1,024	29	179.42
PNB	28,580	0	766,788	1,006,384	7,532	4,071	155.28
SBI	1,610,352	50,043	1,023,581	5,306,195	27,276	36,373	125.53
Uco Bank	10,693	3,568	181	1,315,462	2,288	226	528.99
Union Bank of India	48,642	8,024	341,758	288,334	7,706	1,247	76.71

Interpretation: In April 2025, Indian Bank (556.39), Bank of Maharashtra (537.75), and Uco Bank (528.99) recorded the highest DIS values, indicating a strongly digitised acceptance infrastructure relative to ATM presence. Union Bank of India (76.71) and SBI (125.53) recorded the lowest scores, reflecting continued ATM-heavy infrastructure. SBI's low DIS despite its large absolute digital footprint is attributable to its disproportionately large ATM network, which suppresses the ratio.

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ISSN: 1053-7899
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4.2 Cash Dependency Ratio — April 2025

Table 2: Cash Dependency Ratio — April 2025

Bank	Cash Withdrawal (Cr.)	Card Payment (Cr.)	UPI Value (Cr.)	CDR
Bank of Baroda	1,18,487,332	7,707,528	2,573,124	11.53
Bank of India	63,111,620	5,037,881	1,264,361	10.01
Bank of Maharashtra	28,753,672	2,325,662	941,058	8.80
Canara Bank	1,41,882,963	15,535,750	3,799,380	7.34
Central Bank of India	39,340,782	3,348,015	2,016,531	7.33
Indian Bank	90,473,666	7,987,076	2,916,477	8.30
Indian Overseas Bank	50,266,967	5,202,584	462,806	8.87
P&S Bank	6,428,638	732,794	185,031	7.00
PNB	1,21,739,903	10,222,563	1,006,384	10.84
SBI	8,42,000,000	78,799,442	5,306,195	10.01
Uco Bank	30,516,925	2,387,197	1,315,462	8.24
Union Bank of India	1,24,106,968	10,200,135	288,334	11.83

Interpretation: Union Bank of India (11.83) and Bank of Baroda (11.53) exhibit the highest cash dependency in April 2025, indicating that customer transactions are disproportionately cash-driven. Canara Bank (7.34), Central Bank of India (7.33), and P&S Bank (7.00) record the lowest CDR values, reflecting greater digital transaction maturity and lower compliance risk from cash-intensive operations

4.1.1 Digital Infrastructure Score — May 2025

Table 3: Digital Infrastructure Score — May 2025

Bank	PoS	Micro ATMs	Bharat QR	UPI QR	On-site ATMs	Off-site ATMs	DIS
Bank of Baroda	52,013	44,469	24,245	2,614,504	8,699	2,415	246.11
Bank of India	18,508	23,320	0	1,273,280	5,323	2,677	164.39
Bank of Maharashtra	105	5,605	355,014	943,325	2,187	250	535.10
Canara Bank	77,302	9,045	0	3,262,838	9,246	3,629	260.13
Central Bank of India	3,333	2,687	36,258	2,022,310	2,896	1,189	505.41
Indian Bank	19,898	15,002	0	2,849,743	4,777	628	533.70
Indian Overseas Bank	0	10,579	0	469,577	2,766	734	137.19
P&S Bank	1,025	1,760	1,171	188,059	1,023	29	182.52
PNB	26,142	0	768,214	1,078,844	7,390	3,949	165.20
SBI	1,617,832	50,762	1,024,363	5,373,349	27,458	36,105	126.90
Uco Bank	10,766	3,568	179	1,334,721	2,390	225	515.96
Union Bank of India	50,642	8,055	347,069	288,973	7,706	1,247	77.60

Interpretation: In May 2025, Bank of Maharashtra (535.10), Central Bank of India (505.41), and Indian Bank (533.70) maintain DIS values above 500, confirming sustained digital infrastructure strength. Canara Bank records a notable decline (260.13) from April, attributable to changes in UPI QR acceptance data. Union Bank of India (77.60) remains the lowest performer, highlighting a persistent compliance gap.

Table 4: Cash Dependency Ratio — May 2025

Bank	Cash Withdrawal (Cr.)	Card Payment (Cr.)	UPI Value (Cr.)	CDR
Bank of Baroda	1,16,858,929	7,194,341	2,614,504	11.91
Bank of India	63,124,080	4,698,274	1,273,280	10.57
Bank of Maharashtra	27,836,305	2,206,943	943,325	8.84
Canara Bank	1,42,947,110	15,849,469	3,262,838	7.48
Central Bank of India	39,060,407	3,309,494	2,022,310	7.33
Indian Bank	89,595,031	6,828,125	2,849,743	9.26
Indian Overseas Bank	52,182,364	5,179,723	469,577	9.24
P&S Bank	4,178,581	467,469	188,059	6.37
PNB	1,25,700,870	9,951,572	1,078,844	11.40
SBI	8,37,615,331	73,018,461	5,373,349	10.68
Uco Bank	30,620,775	2,200,055	1,334,721	8.66
Union Bank of India	1,25,499,393	9,444,703	288,973	12.89

Interpretation: In May 2025, Union Bank of India records the highest CDR (12.89), suggesting growing cash dependency and elevated compliance burden. P&S Bank achieves the lowest CDR (6.37), indicating strong digital transaction dominance and corresponding fintech maturity. The month-wise Pearson correlation for May is $r = -0.465$ ($p = 0.127$), which is directionally consistent but not statistically significant at the 5% level, suggesting greater monthly variance.

4.2.1 Digital Infrastructure Score — June 2025

Table 5: Digital Infrastructure Score — June 2025

Bank	PoS	Micro ATMs	Bharat QR	UPI QR	On-site ATMs	Off-site ATMs	DIS
Bank of Baroda	52,130	44,362	24,248	2,658,077	8,710	2,420	249.67
Bank of India	18,450	23,603	0	1,292,420	5,339	2,647	167.10
Bank of Maharashtra	115	5,762	355,014	945,478	2,214	250	530.18
Canara Bank	77,793	9,640	0	3,361,623	7,274	3,572	318.00
Central Bank of India	3,371	2,712	37,068	2,071,523	2,899	1,189	517.29
Indian Bank	19,910	15,080	0	2,738,620	4,829	637	507.43
Indian Overseas Bank	0	10,872	0	477,768	2,728	732	141.23
P&S Bank	1,052	1,776	1,198	193,073	1,027	29	186.65
PNB	25,616	0	769,536	1,156,023	7,341	3,899	173.59
SBI	1,636,331	51,217	1,022,316	5,438,480	27,478	34,997	130.43
Uco Bank	10,813	3,568	168	1,351,843	2,336	220	534.58
Union Bank of India	50,803	8,042	352,011	289,409	7,701	1,194	78.73

Interpretation: June 2025 shows a stabilisation of DIS values across the sample. Uco Bank (534.58), Central Bank of India (517.29), and Bank of Maharashtra (530.18) maintain scores above 500. Canara Bank partially recovers (318.00). Union Bank of India (78.73) remains structurally the weakest, presenting an ongoing entrepreneurial opportunity for RegTech solution providers. The month-wise correlation strengthens to $r = -0.659$ ($p = 0.020$), statistically significant at the 5% level.

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ISSN: 1053-7899
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Table 6: Cash Dependency Ratio — June 2025

Bank	Cash Withdrawal (Cr.)	Card Payment (Cr.)	UPI Value (Cr.)	CDR
Bank of Baroda	1,07,766,070	6,606,462	2,658,077	11.63
Bank of India	59,003,198	4,335,662	1,292,420	10.48
Bank of Maharashtra	26,336,019	2,074,966	945,478	8.72
Canara Bank	1,36,817,544	14,033,589	3,361,623	7.87
Central Bank of India	35,814,628	2,952,845	2,071,523	7.13
Indian Bank	87,502,452	6,433,737	2,738,620	9.54
Indian Overseas Bank	49,793,154	4,779,084	477,768	9.47
P&S Bank	3,818,834	258,952	193,073	8.45
PNB	1,14,858,742	9,093,019	1,156,023	11.21
SBI	7,79,182,500	68,118,962	5,438,480	10.59
Uco Bank	28,524,413	2,012,118	1,351,843	8.48
Union Bank of India	1,25,529,817	8,933,908	289,409	13.61

Interpretation: June 2025 sees Union Bank of India's CDR rise to 13.61, the highest recorded across all months in the study, indicating worsening cash dependency and increasing policy compliance burden. Central Bank of India records the lowest CDR (7.13) in this month, reinforcing its position as a digitally mature institution well-suited for blockchain compliance integration.

4.3.1 Digital Infrastructure Score — July 2025

Table 7: Digital Infrastructure Score — July 2025

Bank	PoS	Micro ATMs	Bharat QR	UPI QR	On-site ATMs	Off-site ATMs	DIS
Bank of Baroda	55,091	43,579	24,361	2,718,439	8,861	2,407	252.17
Bank of India	18,457	23,779	0	1,309,127	5,311	2,510	172.79
Bank of Maharashtra	146	5,862	355,014	948,288	2,274	247	519.36
Canara Bank	78,582	10,333	0	3,521,610	7,226	3,555	334.90
Central Bank of India	3,442	2,776	37,885	2,032,118	2,905	1,196	506.27
Indian Bank	20,000	15,260	0	2,631,750	4,880	635	483.59
Indian Overseas Bank	0	11,082	0	485,940	2,770	722	142.33
P&S Bank	1,076	1,846	1,227	195,835	1,027	29	189.38
PNB	24,241	0	774,229	1,227,644	7,351	3,887	180.29
SBI	1,632,842	51,562	1,025,230	5,511,973	27,575	34,285	132.91
Uco Bank	10,743	3,568	159	1,373,600	2,358	210	540.53
Union Bank of India	52,122	8,051	358,573	290,031	7,699	1,196	79.68

Interpretation: By July 2025, Uco Bank achieves the highest DIS (540.53) in the sample, overtaking Bank of Maharashtra and Indian Bank. This reflects consistent growth in digital acceptance points relative to ATM infrastructure. Indian Bank's DIS declines slightly (483.59), dropping below the 500 threshold. The month-wise Pearson correlation reaches $r = -0.723$ ($p = 0.008$), the strongest observed across the study period.

Table 8: Cash Dependency Ratio — July 2025

Bank	Cash Withdrawal (Cr.)	Card Payment (Cr.)	UPI Value (Cr.)	CDR
Bank of Baroda	1,08,811,780	6,632,110	2,718,439	11.64
Bank of India	59,929,468	4,394,048	1,309,127	10.51
Bank of Maharashtra	27,241,672	2,076,984	948,288	9.00
Canara Bank	1,39,743,356	14,507,021	3,521,610	7.75
Central Bank of India	35,959,082	2,873,648	2,032,118	7.33
Indian Bank	90,189,361	6,602,295	2,631,750	9.77
Indian Overseas Bank	51,068,889	4,903,477	485,940	9.48
P&S Bank	4,348,031	195,767	195,835	11.10
PNB	1,13,779,246	9,182,088	1,227,644	10.93
SBI	7,89,695,589	70,707,467	5,511,973	10.36
Uco Bank	28,884,896	2,006,964	1,373,600	8.54
Union Bank of India	1,20,648,069	9,139,304	290,031	12.79

Interpretation: July 2025 marks an important development in the CDR analysis: P&S Bank's CDR rises sharply to 11.10, a significant increase from June's 8.45. This volatility in a small bank's CDR highlights that cash dependency can be influenced by seasonal transaction patterns and should be interpreted alongside structural trends. Union Bank of India (12.79) and Bank of Baroda (11.64) remain high-CDR banks. Central Bank of India (7.33) continues to lead in digital transaction maturity.

4.4.1 Digital Infrastructure Score — August 2025

Table 9: Digital Infrastructure Score — August 2025

Bank	PoS	Micro ATMs	Bharat QR	UPI QR	On-site ATMs	Off-site ATMs	DIS
Bank of Baroda	55,323	41,494	24,725	2,782,894	8,929	2,460	255.02
Bank of India	18,471	24,330	0	1,322,455	5,298	2,505	174.97
Bank of Maharashtra	159	6,002	355,014	950,883	2,304	247	514.33
Canara Bank	84,600	10,711	0	3,671,498	7,276	3,549	347.97
Central Bank of India	3,283	2,666	38,138	2,033,444	2,930	1,205	502.43
Indian Bank	20,199	15,396	0	2,618,589	4,911	639	478.23
Indian Overseas Bank	0	11,318	0	496,027	2,818	724	143.24
P&S Bank	1,098	1,900	1,248	199,295	1,042	35	188.99
PNB	24,424	0	776,798	1,300,487	7,318	3,883	187.64
SBI	1,604,537	52,081	1,020,401	5,576,576	27,590	34,240	133.49
Uco Bank	10,707	3,568	151	1,393,401	2,380	216	542.31
Union Bank of India	52,215	8,095	364,365	290,864	7,699	1,196	80.44

Interpretation: August 2025 continues the trend of Uco Bank leading the DIS ranking (542.31). Bank of Maharashtra (514.33) and Central Bank of India (502.43) maintain scores above 500. Indian Bank's decline (478.23) from its April peak reflects marginal deterioration in its digital-to-ATM ratio. Union Bank of India's DIS (80.44) remains virtually unchanged over the six-month period, suggesting structural inertia rather than cyclical fluctuation

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Table 10: Cash Dependency Ratio — August 2025

Bank	Cash Withdrawal (Cr.)	Card Payment (Cr.)	UPI Value (Cr.)	CDR
Bank of Baroda	1,11,812,546	6,625,698	2,782,894	11.88
Bank of India	63,366,444	4,717,811	1,322,455	10.49
Bank of Maharashtra	28,853,271	2,204,377	950,883	9.14
Canara Bank	1,42,212,768	15,266,455	3,671,498	7.51
Central Bank of India	36,717,266	2,978,636	2,033,444	7.33
Indian Bank	91,875,956	6,922,973	2,618,589	9.63
Indian Overseas Bank	52,549,692	5,174,284	496,027	9.27
P&S Bank	5,520,430	208,595	199,295	13.53
PNB	1,15,733,899	9,007,461	1,300,487	11.23
SBI	8,17,558,266	72,769,425	5,576,576	10.44
Uco Bank	29,867,497	2,066,695	1,393,401	8.63
Union Bank of India	1,22,782,493	9,142,562	290,864	13.02

Interpretation: August 2025 presents the most pronounced CDR outlier in the study: P&S Bank records a CDR of 13.53, the highest single monthly value observed across all banks and months. This spike is driven by a sharp increase in cash withdrawals relative to card and UPI activity, and is likely attributable to specific transaction events or data reporting adjustments rather than a structural shift. Central Bank of India (7.33) maintains the lowest CDR, consistent with every month in the study.

4.5.1 Digital Infrastructure Score — September 2025

Table 11: Digital Infrastructure Score — September 2025

Bank	PoS	Micro ATMs	Bharat QR	UPI QR	On-site ATMs	Off-site ATMs	DIS
Bank of Baroda	55,231	42,235	24,709	2,847,996	8,976	2,481	259.25
Bank of India	18,750	24,886	0	1,337,146	5,196	2,500	179.42
Bank of Maharashtra	159	5,997	355,014	952,740	2,321	250	511.05
Canara Bank	86,392	11,076	0	3,855,241	7,332	3,532	363.84
Central Bank of India	3,370	2,741	38,138	2,074,385	2,948	1,218	508.55
Indian Bank	20,277	15,597	0	2,590,962	4,925	640	472.03
Indian Overseas Bank	0	11,467	0	504,075	2,841	726	144.53
P&S Bank	1,107	1,919	1,253	205,466	1,053	37	192.43
PNB	23,815	0	351,363	1,351,586	7,304	3,883	154.35
SBI	1,645,821	52,719	1,023,057	5,640,748	28,848	33,728	133.64
Uco Bank	10,709	3,568	151	1,410,260	2,377	216	549.44
Union Bank of India	53,428	8,059	369,473	291,785	7,866	1,196	79.76

Interpretation: September 2025 marks the end of the study period, with Uco Bank achieving its highest DIS of 549.44. Bank of Maharashtra (511.05) and Central Bank of India (508.55) maintain strong positions. A notable decline is observed in PNB's DIS (154.35) compared to August (187.64), partly attributable to a reduction in Bharat QR registrations. Canara Bank (363.84) shows consistent improvement over the six-month period. The month-wise correlation reaches $r = -0.717$ ($p = 0.009$).

Table 12: Cash Dependency Ratio — September 2025

Bank	Cash Withdrawal (Cr.)	Card Payment (Cr.)	UPI Value (Cr.)	CDR
Bank of Baroda	1,07,863,257	6,123,670	2,847,996	12.02
Bank of India	59,415,231	4,152,661	1,337,146	10.82
Bank of Maharashtra	26,656,670	2,004,018	952,740	9.02
Canara Bank	1,37,580,891	14,049,490	3,855,241	7.68
Central Bank of India	34,912,852	2,978,789	2,074,385	6.91
Indian Bank	89,909,508	6,473,838	2,590,962	9.92
Indian Overseas Bank	50,906,168	4,695,821	504,075	9.79
P&S Bank	5,652,057	187,921	205,466	14.37
PNB	1,13,849,676	8,754,621	1,351,586	11.27
SBI	7,89,492,847	68,013,827	5,640,748	10.72
Uco Bank	29,886,204	2,097,796	1,410,260	8.52
Union Bank of India	1,18,809,305	8,505,984	291,785	13.50

Interpretation: In September 2025, P&S Bank records its highest CDR (14.37), driven by elevated cash withdrawals relative to digital payments. Central Bank of India achieves its lowest CDR across the study period (6.91), further strengthening its position as the most digitally mature public sector bank in the sample. Union Bank of India (13.50) remains structurally cash-dependent, underscoring a persistent policy challenge.

4.7 Correlation Analysis: DIS and CDR

To test whether digital infrastructure strength is systematically associated with reduced cash dependency, a Pearson product-moment correlation was computed between the six-month average DIS and CDR values of all 12 banks. Table 13 presents the average values.

Table 13: Six-Month Average DIS and CDR by Bank

Bank	Average DIS	Average CDR	BRI
Central Bank of India	507.67	7.23	0.9395
Uco Bank	535.30	8.51	0.7751
Bank of Maharashtra	524.63	8.92	0.6802
Indian Bank	505.23	9.40	0.5531
Canara Bank	329.50	7.61	0.4829
Indian Overseas Bank	140.64	9.35	−0.2368
P&S Bank	186.57	10.14	−0.2733
Bank of India	170.32	10.48	−0.3690
Bank of Baroda	251.02	11.77	−0.4177
SBI	130.48	10.47	−0.4539
PNB	169.39	11.15	−0.4877
Union Bank of India	78.82	12.94	−1.0000

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Vol. 36 Issue 1s, 2026, Pages: 3552-3558

The Pearson correlation between average DIS and average CDR across the 12 banks is r = −0.711 (p = 0.0095). This constitutes a strong, statistically significant negative correlation, indicating that banks with more digitised acceptance infrastructure systematically exhibit lower customer cash dependency. A Spearman rank correlation (ρ = −0.699, p = 0.011) confirms this finding as robust to distributional assumptions.

Table 14: Month-wise Pearson Correlation (DIS vs CDR)

Month	Pearson r	p-value	Significance
April 2025	−0.5631	0.0566	Marginally significant (p < 0.10)
May 2025	−0.4650	0.1277	Not significant
June 2025	−0.6589	0.0198	Significant (p < 0.05)
July 2025	−0.7227	0.0079	Significant (p < 0.01)
August 2025	−0.6771	0.0156	Significant (p < 0.05)
September 2025	−0.7166	0.0087	Significant (p < 0.01)

The month-wise analysis reveals that the DIS–CDR correlation strengthens over the study period, from r = −0.563 in April to r = −0.717 in September (with a temporary weakening in May, r = −0.465). This trend suggests that the divergence between digitally advanced and cash-dependent banks is widening over time, with implications for the pace and equity of blockchain adoption across the sector.

4.8 Quadrant Classification

Using the 12-bank median DIS (218.79) and median CDR (9.77) as thresholds, banks are classified into four readiness quadrants.

Table 15: Blockchain Readiness Quadrant Classification

Quadrant	Criteria	Banks	Implication
Q1 Blockchain Ready	High DIS, Low CDR	Central Bank of India, Uco Bank, Bank of Maharashtra, Indian Bank, Canara Bank	Immediate candidates for blockchain compliance integration
Q2 Partial Readiness	High DIS, High CDR	Bank of Baroda	Strong infrastructure but customer behaviour requires digital nudging
Q3 Digital Dependent	Low DIS, Low CDR	Indian Overseas Bank	Customers are digital but infrastructure lags; targeted upgrades required
Q4 Least Ready	Low DIS, High CDR	Union Bank of India, PNB, SBI, Bank of India, P&S Bank	Require comprehensive digital transformation before blockchain adoption

5. DISCUSSION

5.1 Entrepreneurial Opportunities: The quadrant classification and BRI ranking identify clear and differentiated entrepreneurial opportunities across the Indian public sector banking landscape. For Q1 banks Central Bank of India, Uco Bank, Bank of Maharashtra, Indian Bank, and Canara Bank the digital infrastructure and transaction environment is already sufficiently advanced to support pilot deployment of permissioned blockchain networks for KYC, AML, and compliance reporting. RegTech startups offering smart contract-based compliance automation, real-time audit trail generation, and cross-bank KYC sharing platforms will find the most receptive institutional environment in this quadrant. The RBI's regulatory sandbox framework provides a structured pathway for such deployments. For Q4 banks Union Bank of India, PNB, SBI, Bank of India, and P&S Bank the opportunity is at an earlier stage of the value chain. Digital infrastructure upgrade services, UPI QR expansion programmes, and cash-to-digital migration consulting represent higher-priority interventions before blockchain compliance layers can be meaningfully deployed. FinTech companies offering digital onboarding, last-mile payment infrastructure, and cash management optimisation solutions will find demand in this segment. SBI's position in Q4 is notable: despite its absolute scale, its ratio-based DIS is suppressed by its legacy ATM dominance, presenting a large-scale digital rationalisation opportunity.

5.2 Policy Challenges: Several policy challenges emerge from the analysis. First, the absence of a uniform blockchain policy framework for Indian banking creates regulatory uncertainty that discourages investment in blockchain compliance infrastructure even by Q1 banks. A clear RBI circular specifying permissible use cases, data localisation requirements, and audit standards for blockchain-based compliance systems would significantly accelerate adoption. Second, the data heterogeneity observed across banks particularly the incomplete Bharat QR data for several institutions suggests that RBI's reporting standards require harmonisation to support the kind of cross-bank comparisons that blockchain interoperability demands. Third, the widening DIS–CDR divergence observed over the study period raises equity concerns: if blockchain-based compliance becomes the regulatory standard, Q4 banks may face disproportionate compliance costs relative to Q1 peers, potentially disadvantaging their customers and creating systemic risk concentration. Finally, the study highlights the need for a public-private collaboration model analogous to the NPCI's role in UPI to develop a shared blockchain compliance infrastructure that distributes the fixed costs of deployment across the sector. Such a model would allow Q4 banks to participate in blockchain-based compliance without individually bearing the full cost of infrastructure development.

6. CONCLUSION

This study has proposed and empirically validated a novel, data-driven framework for assessing blockchain adoption readiness among Indian public sector banks. Using two proxy indicators derived from RBI payment system statistics — the Digital Infrastructure Score (DIS) and the Cash Dependency Ratio (CDR) the study demonstrates a strong, statistically significant negative correlation between digital infrastructure strength and cash dependency (Pearson r = −0.711, p = 0.0095; Spearman ρ = −0.699, p = 0.011) across 12 public sector banks over six months (April–September 2025). A Composite Blockchain Readiness Index (BRI), constructed by normalising and combining both metrics, ranks Central Bank of India, Uco Bank, Bank of Maharashtra, Indian Bank, and Canara Bank as the most blockchain-ready institutions. Union Bank of India and PNB occupy the lowest positions. A quadrant classification framework further differentiates banks by their specific readiness profile, enabling targeted policy and entrepreneurial recommendations for each segment. The study's primary theoretical contribution is the operationalisation of digital infrastructure readiness and cash dependency as blockchain adoption proxies, supported by empirical validation of their negative relationship. Its primary practical contribution is the BRI — a reproducible, publicly-derivable metric that regulators, banks, and FinTech investors can use to track blockchain readiness across the Indian banking system over time. Future research should extend this framework by incorporating additional proxy variables such as mobile banking penetration, core banking system vintage, and regulatory sandbox participation rates; and by applying the BRI to private sector and cooperative banks. Longitudinal tracking of BRI scores across multiple years would enable trend analysis of the sector's aggregate blockchain readiness trajectory.

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Vol. 36 Issue 1s, 2026, Pages: 3552-3558

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