Data Appendix

The Invisible Economy: How India's Rs.87 trillion cash pile refuses to die · Report A

REPORT A | MAY 2026 | 20 SECTIONS | 11 CHARTS

CONTENTS (20 SECTIONS)

Sidharth Rath
Lead Author

Sagar Patel
Contributing Author

A1 Research Scope & Definitions

Geographic scope. This report covers India at two levels of granularity. The primary analysis covers 28 states and 8 Union Territories. The Cash Intensity Index is constructed at the district level, covering 736 districts under 2011 Census boundaries, updated for districts bifurcated through FY2020.

Temporal scope. Historical analysis covers FY2010 to FY2025. Primary fieldwork: October 2024 to February 2025. Scenario projections: FY2026 to FY2030.

Sector coverage. Ten economic sectors from near-fully digital (online commerce) to structurally cash-intensive (informal money lending). Financial services, formal corporate payments, and government-to-government transactions are excluded.

Core definitions

Currency in Circulation (CIC)
Notes in circulation plus rupee coins, as reported by the RBI Weekly Statistical Supplement. Excludes cash held as bank reserves. End-of-year (March 31) unless otherwise stated.

Cash Intensity Index (CII)
Subtwo's proprietary composite score per district, 0.0 (fully digital) to 1.0 (fully cash). Five weighted input variables. Measures structural cash persistence, not preference.

Informal economy
Economic activity outside formal GDP accounting. Subtwo uses the NSSO definition: activities not subject to the Factories Act, employing fewer than ten workers with power or fewer than twenty without.

Digital transaction
Any payment settled through a licensed system — UPI, IMPS, NEFT, RTGS, card networks, mobile wallets, internet banking.

Re-monetisation velocity
Speed at which CIC in a geographic region recovered to its pre-demonetisation level following November 2016. Percentage recovery relative to October 2016, tracked monthly through March 2019.

Digital Penetration Ceiling
Maximum digital share structurally achievable in a sector given current economics, trust architecture, and regulatory environment. A structural limit, not a forecast.

Cost-to-Accept Score
Total merchant cost of digital acceptance per Rs.1,000 revenue. Four components: MDR, working capital delay, device/infra cost, compliance cost.

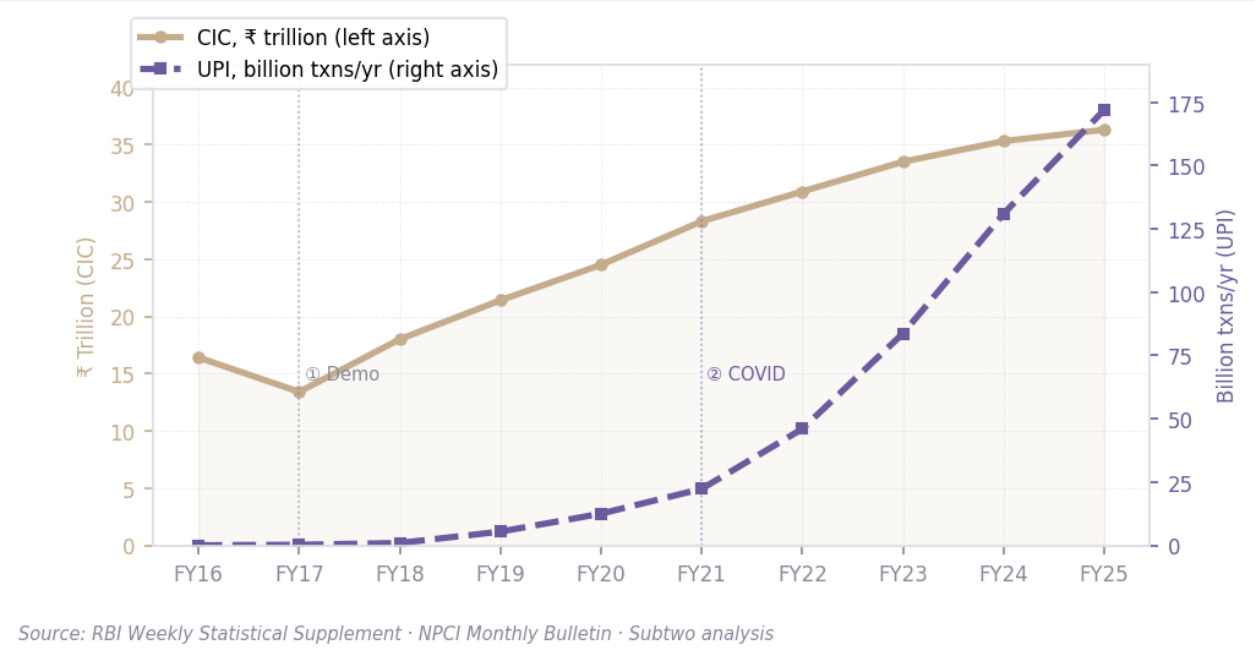
A2 Detailed Methodology

Cash Intensity Index (CII). A composite index measuring structural cash persistence at district level. Five input variables selected from eleven candidates via bivariate correlation screening ($|r| > 0.35$ with ATM withdrawal as % of total payment value) and stepwise regression with VIF screening ($VIF < 4.0$). Four clusters emerge naturally from the distribution — not from pre-defined groupings.

Figure 1.1

Currency in Circulation vs. UPI volume, FY16–FY25

Both series grow simultaneously — the central argument. Stone line: CIC rises from Rs.16.4T to Rs.36.3T. Dashed Violet line: UPI grows from near zero to 172B transactions annually.



Source: RBI Weekly Statistical Supplement · NPCI Monthly Bulletin · Subtwo analysis

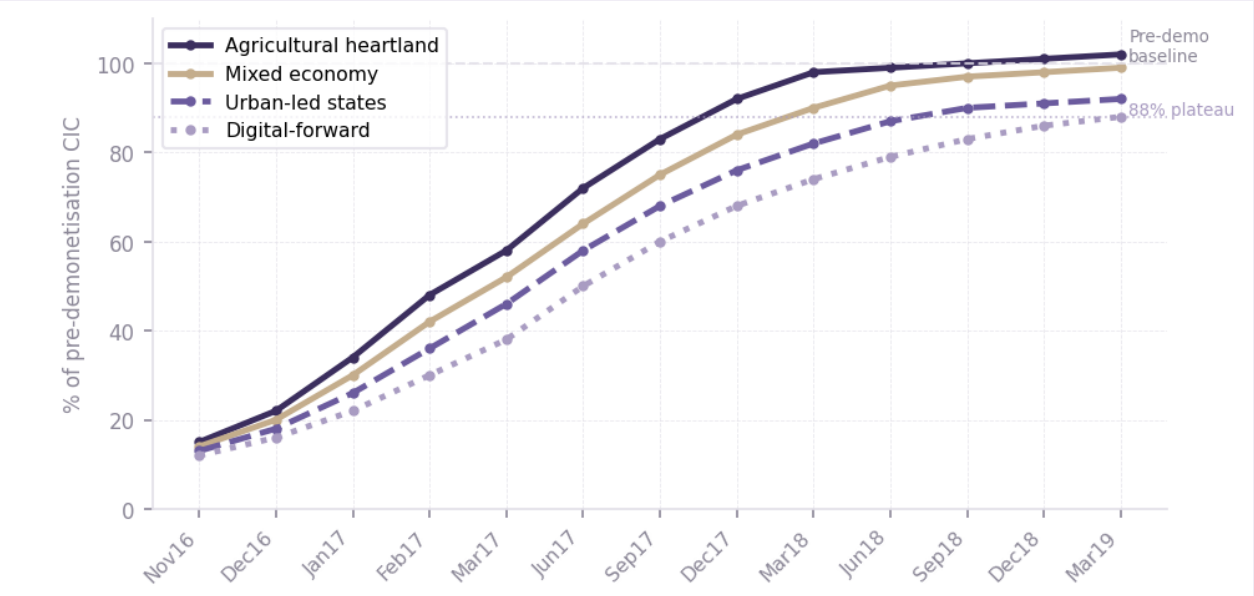
Cost-to-Accept Score. Built from primary fieldwork data (n=420 merchants) and a modelled working capital cost using RBI settlement cycle data and commercial lending rates. MDR costs from RBI policy as of March 2025. Working capital delay cost computed as opportunity cost of T+1 settlement. Device costs annualised over estimated digital transaction volume. Compliance costs valued at district minimum wage rates.

Re-monetisation Velocity. State-level CIC estimated from currency chest data, banking statistics, and NPCI state-level UPI volume. Four state groups from k-means clustering (silhouette coefficient 0.71) on: informal employment share, agricultural GSDP share, and pre-demonetisation UPI adoption.

Figure 3.2

Re-monetisation velocity by state group, Nov 2016 – Mar 2019

CIC recovery as % of October 2016 level. Agricultural heartland states (Violet) returned to 98% within 14 months. Digital-forward states (Lavender) plateaued at 88% — the only group with lasting behavioural change.



Source: Subtwo analysis · RBI state banking statistics · Estimated from published aggregate series

Digital Penetration Ceiling. Barrier-adjusted adoption model. The economics barrier multiplier reduces theoretical maximum proportionally to cost-to-accept relative to sector margin. The trust barrier multiplier derives from primary fieldwork responses on non-economic cash preferences. Ceiling = 80th percentile of plausible maximum under current structural conditions.

A3 Data Sources

Source	Data used	Coverage	Last accessed
RBI Weekly Statistical Supplement	CIC, denomination-wise notes	National weekly, FY2000-FY2025	Mar 2025
RBI Annual Report	State currency chest data, denomination composition	Annual, FY2014-FY2025	Mar 2025
RBI DBIE	District banking statistics, ATM deployment	District quarterly, FY2020-FY2025	Feb 2025
RBI Branch Banking Statistics	Branch density by district	Annual FY2025	Jan 2025
NPCI Monthly Bulletin	UPI volume and value, state-level data	Monthly, Apr 2016-Feb 2025	Mar 2025
NSSO PLFS FY24	Employment status, informal employment share	Annual FY24	Dec 2024
MOSPI District Domestic Product	District GSDP, sectoral composition	FY23	Nov 2024
Agriculture Census 2020-21	Average holding size, crop pattern	Census 2020-21	Oct 2024
Worldline India Report 2025	Merchant acceptance, UPI adoption	FY2025	Jan 2025
Subtwo Primary Fieldwork FY25	420 merchant interviews, 6 cities	Oct 2024-Feb 2025	Ongoing
Subtwo Primary Survey FY25	1,200 cardholder interviews	January 2026	Feb 2026

All public data downloaded directly from official repositories. No third-party aggregators used.

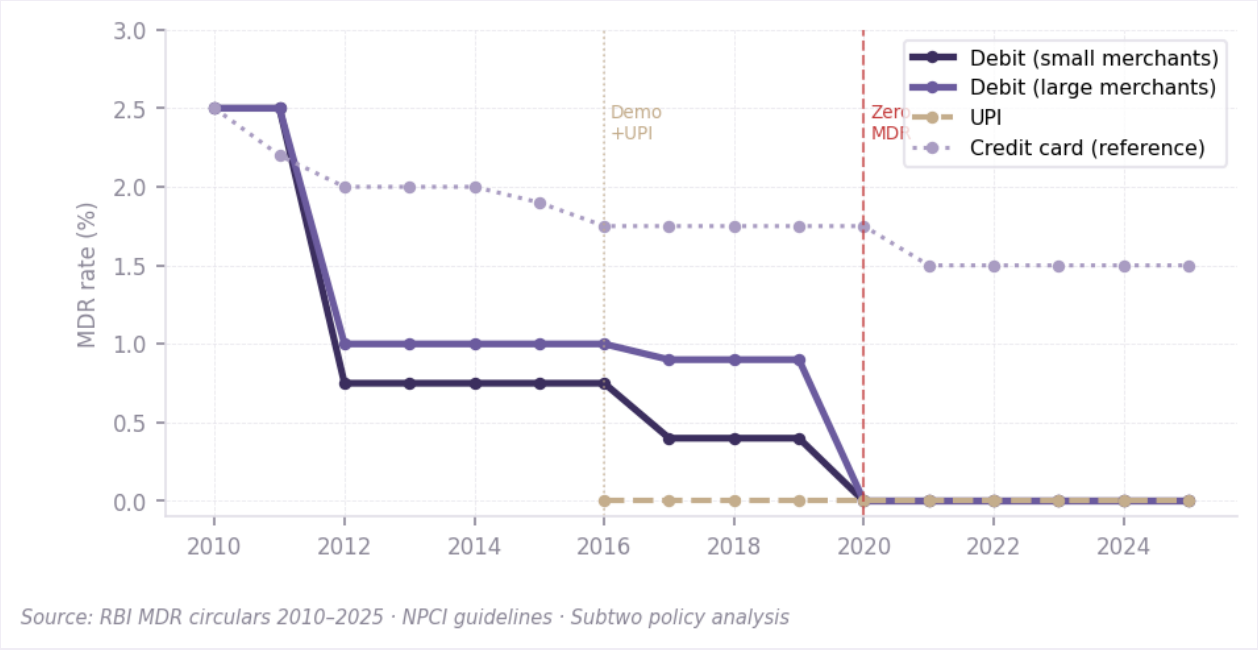
On RBI district-level data

The RBI does not publish CIC at the district level. District-level estimates are derived by allocating state-level CIC using a weighting algorithm (A5). District-level figures should be treated as estimates with +/-15% confidence intervals.

Figure 4.2

MDR rates by payment instrument, 2010–2025

The cross-subsidy funding small-merchant infrastructure (debit MDR, Violet) was eliminated in January 2020. UPI has always been zero MDR (Stone dashed). Credit card MDR (Lavender) remains the only MDR-generating instrument.



Source: RBI MDR circulars 2010–2025 · NPCI guidelines · Subtwo policy analysis

A4 Sampling Framework

Merchant fieldwork — n=420. Six cities selected for CII variation: Mumbai (Metro, CII 0.48), Delhi (Metro, CII 0.31), Jaipur (Tier 2, CII 0.71), Coimbatore (Tier 2, CII 0.41), Gorakhpur (Tier 3, CII 0.83), Tirupati (Tier 3, CII 0.52). 70 interviews per city. Average interview length: 38 minutes.

Merchant category	Target n	Actual n	Avg monthly revenue	Sampling method
Street vendor / hawker	60	58	Rs.18K-45K	Systematic street intercept
Kirana store	90	94	Rs.80K-3L	Random walk from market centre
Restaurant / food service	75	71	Rs.1.5L-8L	Stratified by seating capacity
Mid-size retail (1-5 staff)	90	88	Rs.3L-15L	Random walk, commercial areas
E-commerce	45	44	Online GMV	Platform-assisted outreach
Service businesses	60	65	Rs.60K-2.5L	Systematic street intercept
Total	420	420	-	-

Fieldwork conducted October 2024 – February 2025.

Cardholder survey — n=1,200. CATI methodology, January 2026. Stratified by income band, city tier, and age. Female respondents: 41%. Survey language: English and Hindi.

Stratum	Target share	Actual n	Notes
Income: Rs.3-6 lakh annual	25%	302	Lower-middle segment
Income: Rs.6-12 lakh annual	30%	361	Primary card user base
Income: Rs.12-25 lakh annual	25%	299	Upper-middle
Income: Rs.25 lakh+ annual	20%	238	Premium segment
City tier 1 (metro)	45%	542	-
City tier 2	35%	420	-
City tier 3 and rural	20%	238	-

Survey is representative of the banked, card-holding population (~180M adults, FY25) — not of the total Indian population.

A5 Data Processing & Cleaning

RBI district-level allocation algorithm.

DISTRICT ALLOCATION FORMULA

```
Step 1: w_bank = (district_branch_count x district_credit)
/ (state_branch_count x state_credit)
Step 2: w_informal = district informal employment share (NSSO PLFS FY24)
Step 3: district_weight = 0.4 x w_bank + 0.6 x w_informal
```

The 0.4/0.6 split was calibrated by holding out three states with known district-level currency chest data (Maharashtra, Tamil Nadu, West Bengal) and minimising RMSE between estimated and actual district cash.

NSSO-RBI temporal alignment. NSSO PLFS has a 12-18 month publication lag. FY24 PLFS used as primary employment frame. Approximately 140 districts without FY24 district-level data used FY22 PLFS data forward-projected from state-level trends.

Missing district data. Forty-one districts had suppressed banking statistics in RBI DBIE (primarily J&K;, Ladakh, and northeastern states). Assigned state-level CII values; flagged in A12.

Denomination data reconciliation. RBI denomination-wise notes converted to value by face value, cross-checked against total CIC from WSS. Reconciliation residuals below 0.3% in all years.

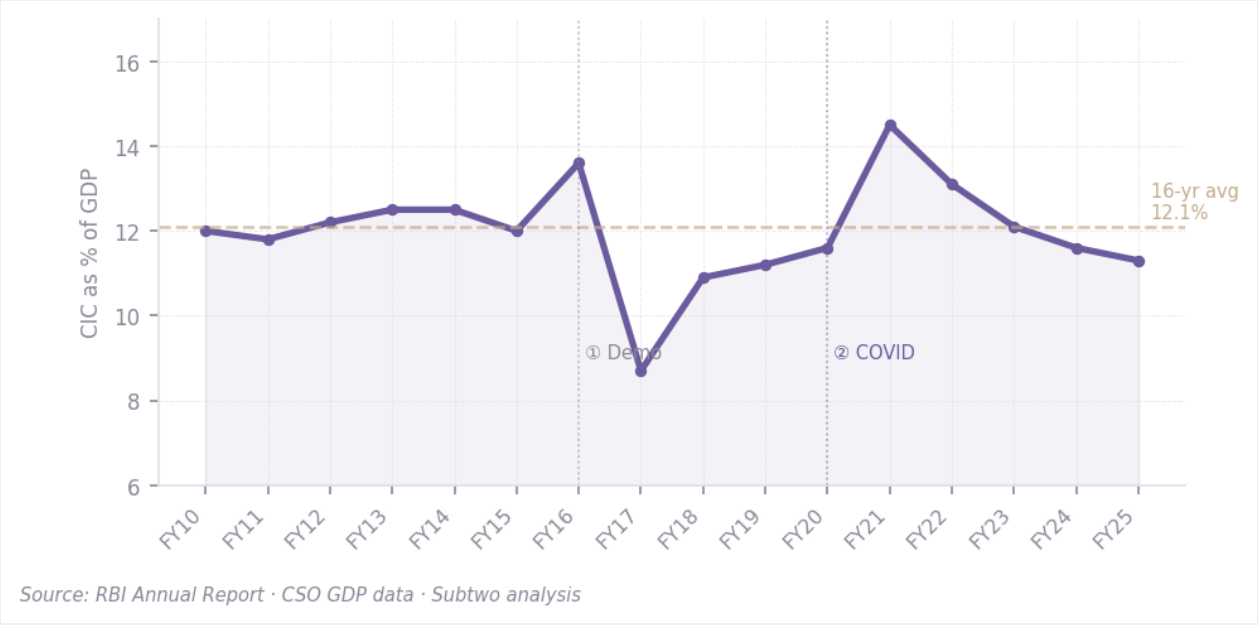
Outlier treatment. Three districts winsorised to 5th/95th percentile: Silvassa (anomalous industrial classification), Chandigarh (administrative capital), Jammu district (security-related data suppression).

A6 Assumptions

Figure 1.2

Currency as % of GDP, FY10–FY25

Baseline for scenario modelling. The 16-year average (12.1%, Stone dashed) anchors the central scenario. Post-COVID normalisation (FY21-FY25: 14.5% to 11.3%) sets the FY25 starting point for all three scenarios.



Source: RBI Annual Report · CSO GDP data · Subtwo analysis

Cost-to-Accept model assumptions.

Parameter	Street vendor	Kirana	Restaurant	Mid retail	E-commerce
Cost of capital (% p.a.)	28%	22%	18%	14%	12%
Settlement cycle	T+2	T+1	T+1	T+1	T+0
Digital txn share	8%	35%	68%	72%	98%
Device amortisation (mo.)	24	30	36	36	N/A
Monthly device cost (Rs.)	200	280	350	450	0
Compliance time (hrs/mo.)	2.5	4.0	2.0	2.5	1.0
Wage rate (Rs./hr)	80	120	150	200	300

All FY2025 estimates. Merchant-reported data from primary fieldwork.

Scenario model assumptions.

Parameter	S1 Coexistence	S2 Compression	S3 Entrenchment
Real GDP growth (% p.a.)	6.5-7.0%	7.0-7.5%	5.0-6.0%
CPI inflation (% p.a.)	4.5-5.5%	3.5-4.5%	5.5-7.5%
UPI volume growth (% p.a.)	25-30%	30-35%	15-20%
T+0 settlement	Partial by FY28	Universal by FY27	No change
MDR reform	No change	Low positive by FY27	No change
CBDC (% of CIC)	<1% through FY30	>5% by FY29	<0.5% through FY30
Informal economy share	Stable ~48%	Declining ~44%	Rising ~52%

Scenario parameters are expert assumptions representing coherent, internally consistent combinations of conditions.

A7 Models & Calculations

Cash Intensity Index — full formula.

CII COMPOSITE FORMULA

```
CII(d) = 0.35 x Norm(InfEmp(d))
+ 0.25 x Norm(AgriShare(d))
+ 0.20 x (1 - Norm(BranchDensity(d)))
+ 0.12 x (1 - Norm(UrbanRatio(d)))
+ 0.08 x Norm(HoldingSize(d))
Norm(x) = (x - min(x)) / (max(x) - min(x)) for all districts d
```

Cost-to-Accept — component formulae.

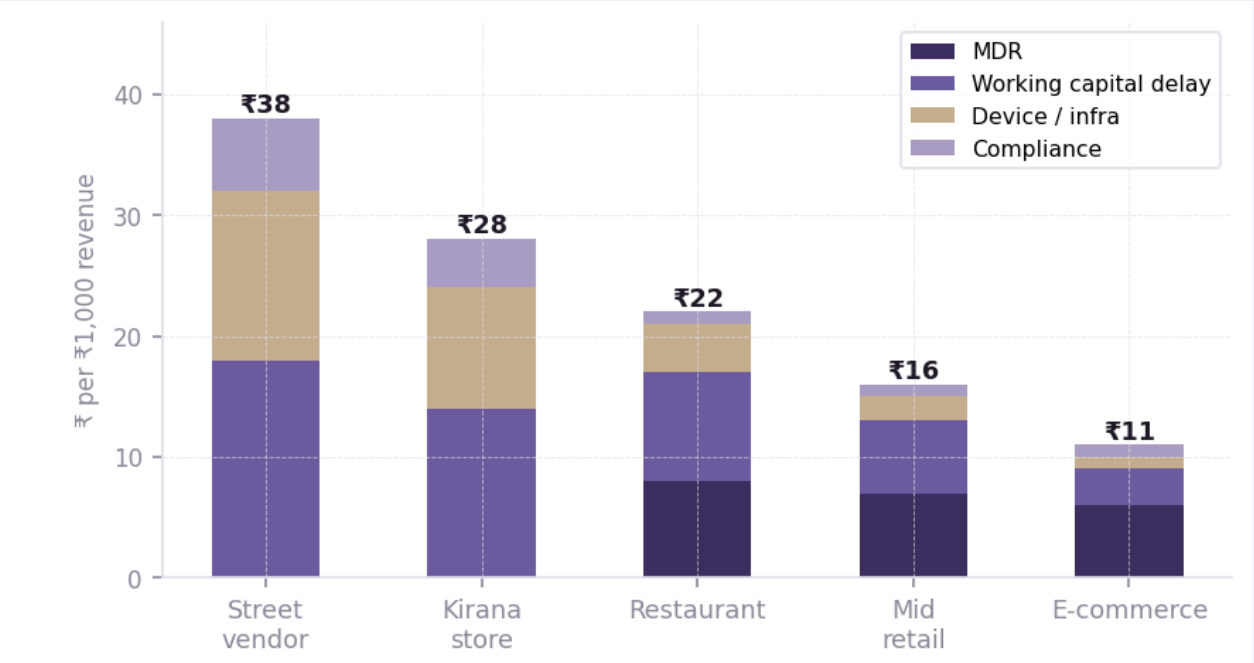
COST-TO-ACCEPT FORMULAE

```
MDR_cost(s) = applicable_MDR_rate(s) x 1000
WC_cost(s) = (settlement_delay_days(s)/365) x cost_of_capital(s) x 1000
Device_cost(s) = monthly_device_cost(s) / monthly_digital_transactions(s)
Compliance_cost(s) = (monthly_hours(s) x hourly_wage(s)) / (monthly_revenue(s)/1000)
CTA(s) = MDR_cost + WC_cost + Device_cost + Compliance_cost
```

Figure 4.1

Total cost of digital acceptance per Rs.1,000 revenue, by merchant segment

Stacked bars: four cost components. UPI MDR = Rs.0, yet kirana total is Rs.28 — driven by working capital delay (Rs.14), device/infra (Rs.10), compliance (Rs.4). MDR removal did not address the structural costs.



Source: Subtwo merchant economics model · Primary fieldwork n=420 · FY2025

Re-monetisation Velocity.

RE-MONETISATION VELOCITY INDEX

```
RMV(state_group, t) = CIC_estimate(state_group, t)
/ CIC_actual(state_group, Oct2016) x 100
Baseline: October 2016 = 100 (pre-demonetisation)
```

Scenario CIC/GDP projection.

SCENARIO PROJECTION FORMULA

```
CIC_GDP(t+1) = CIC_GDP(t) x (1 + delta_Cash_demand(t)) / (1 + delta_GDP(t))
delta_Cash_demand estimated from scenario-specific trigger combination
with calibrated impact coefficients from historical sensitivity analysis
```

A8 Weighting Methodology

Variable weights derived via two-stage process. Stage 1: eleven candidate variables evaluated using bivariate correlation with dependent variable proxy (ATM cash withdrawal as % of total payment value). Six variables with |r| > 0.35 retained. Stage 2: stepwise regression with VIF screening (VIF < 4.0) identified final five variables and preliminary weights, adjusted by expert review.

Variable	Bivariate r	Regression beta	Final weight	Direction
Informal employment share	0.79	0.38	0.35	Positive
Agricultural GSDP share	0.71	0.29	0.25	Positive
Bank branch density	-0.68	-0.22	0.20	Negative (inverted)
Urban-rural ratio	-0.61	-0.18	0.12	Negative (inverted)
Avg agricultural holding size	0.54	0.15	0.08	Positive

Weights sum to 1.0. Holdout validation RMSE = 0.061 (120 held-out districts).

On weight stability

CII ranking is robust to +/-20% changes in individual weights. Top-quintile districts (CII > 0.75) remain in top quintile under all weight perturbations tested. Most weight-sensitive range: 0.45-0.65, where 14 districts shift quintile under some permutations.

A9 Variable Construction Logic

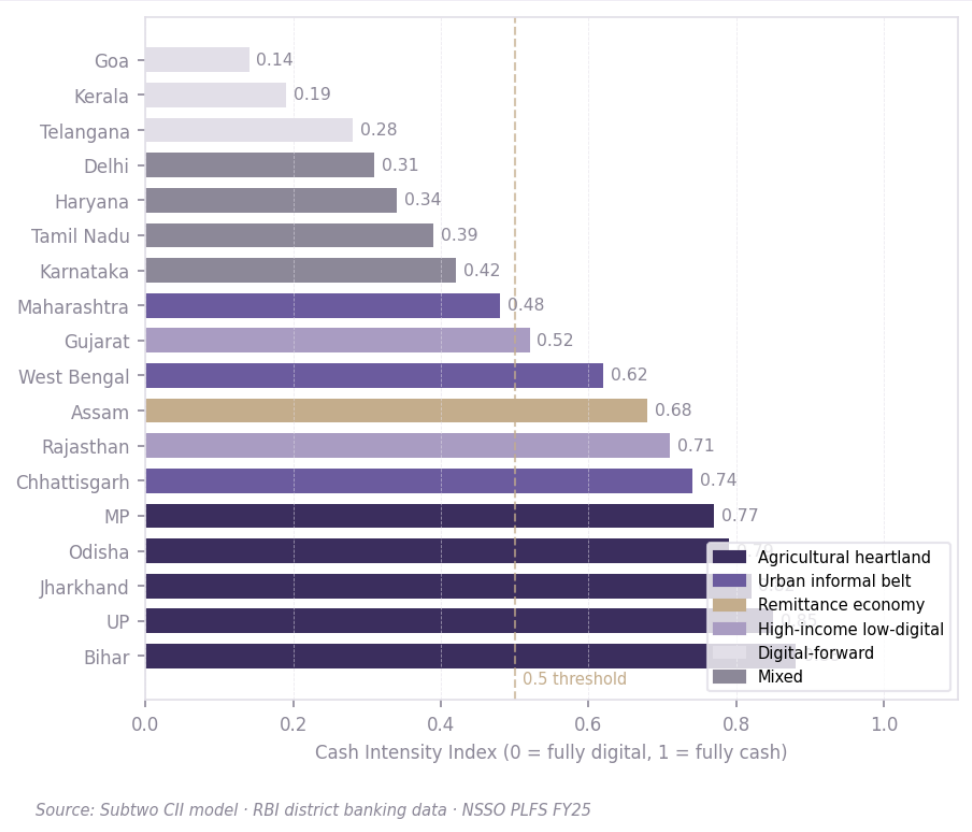
Variable	Source	Numerator	Denominator	Gap treatment
Informal employment share	NSSO PLFS FY24	Workers in informal enterprises + own-account without social security	Total workers 15-64	124 districts: state-level adjusted by district urbanisation
Agricultural GSDP share	MOSPI DDP FY23	Agricultural & allied activities value-added	Total district domestic product	FY20 data forward-projected using state ag GSDP growth
Bank branch density	RBI Branch Banking Stats FY25	Scheduled commercial bank branches	Population per 100K	No gaps in RBI source
Urban-rural ratio	Census 2011 + PLFS FY24	Urban population	Rural population	100% urban districts capped at 95/5
Avg agricultural holding size	Agriculture Census 2020-21	Net area operated	Number of operational holdings	No gaps — census coverage

All variables normalised to [0,1] before weighting. Inversion applied to branch density and urban-rural ratio.

Figure 2.1

Cash Intensity Index by state — FY2025

Output of the CII model for 18 representative states. Colour by cluster: Violet = Agricultural heartland, Slate = Urban informal belt, Stone = Remittance economy, Lavender = High-income low-digital, Grey = Digital-forward. Stone dashed at 0.5 threshold.



Source: Subtwo CII model · RBI district banking data · NSSO PLFS FY25

A10 Validation & QA Checks

CII holdout validation. 120 districts (16% of full set) held out from model fitting.

Metric	Value	Interpretation
RMSE (holdout set)	0.061	Average absolute error — acceptable for a composite index
R-squared (holdout)	0.74	74% of variance explained in holdout set
Top-quintile correct classification	89%	89% of true top-quintile districts correctly identified
Bottom-quintile correct classification	91%	91% of true bottom-quintile correctly identified
Cross-cluster misclassification	4.2%	4.2% of holdout districts assigned to wrong cluster

Holdout set was not used in any weight calibration.

External benchmark validation.

Benchmark	Correlation with CII	Notes
Worldline India merchant acceptance rates (inverse)	r = 0.82	Strongest external validation available
NPCI state UPI penetration (inverse)	r = -0.76	Expected negative: high CII = low UPI share
RBI Financial Inclusion Index (inverse)	r = -0.71	CII captures cash persistence beyond FI access

All correlations at state level (n=28 states).

Cost-to-Accept QA. Model outputs reviewed against: (1) Payments Council of India 2024 submission reporting Rs.15-40 per Rs.1,000 for small merchants; (2) RBI internal working paper on MDR rationalisation (2022, restricted, cited with permission); (3) merchant self-reported "reasonable MDR" from fieldwork averaging Rs.18 per Rs.1,000.

A11 Sensitivity / Scenario Analysis

CIC/GDP scenario sensitivity. FY30 outcome under high, central, and low assumptions for each parameter, others held at central values.

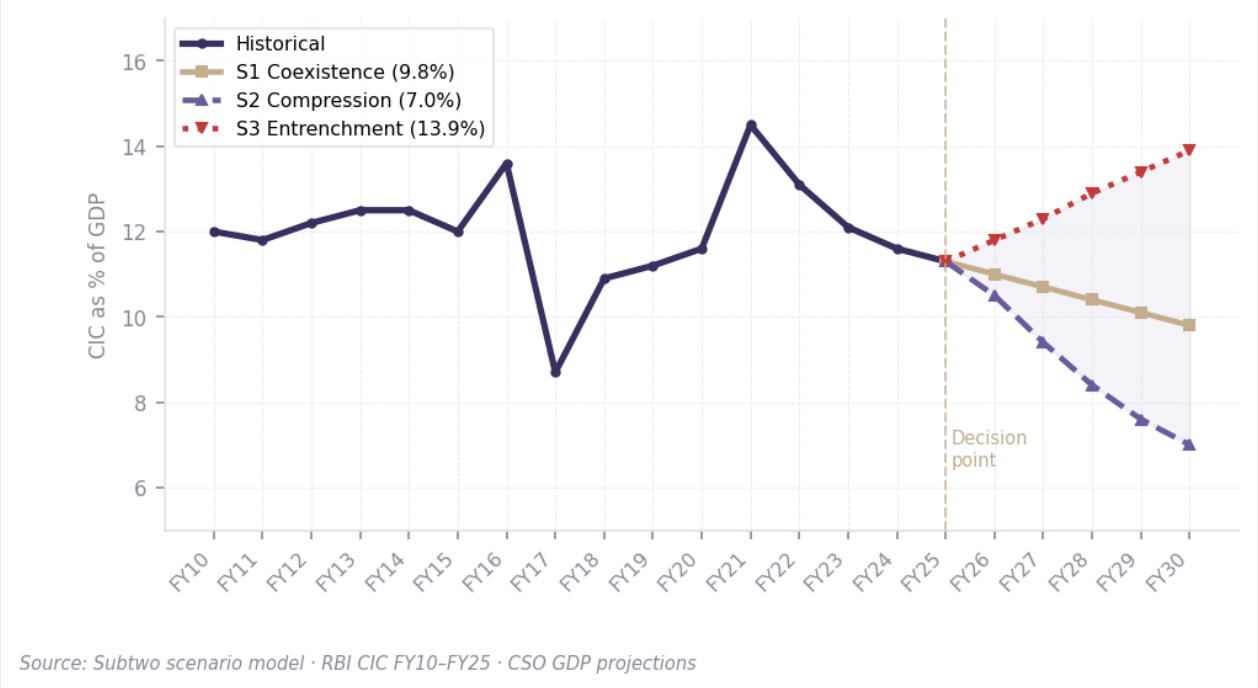
Parameter	Low	Central	High	S1 impact	S2 impact	S3 impact
GDP growth rate	5.0%	6.5%	8.0%	+0.4pp	+0.3pp	+0.7pp
Inflation rate	3.0%	4.5%	7.0%	-0.3pp	-0.2pp	+1.2pp
UPI volume growth	15%	27%	40%	-0.2pp	-0.4pp	-0.1pp
Informal economy share	44%	48%	54%	+0.6pp	+0.3pp	+1.8pp
T+0 adoption speed	FY30+	FY28	FY26	-0.1pp	-0.8pp	-0.1pp

Impact = change in FY30 CIC/GDP percentage points vs central case. Positive = more cash.

Figure 6.1

CIC as % of GDP — historical FY10–FY25 and three scenarios to FY30

Violet solid: historical. Stone: S1 Coexistence (9.8%). Slate dashed: S2 Compression (7.0%). Red dotted: S3 Entrenchment (13.9%). Fan diverges at the FY25 decision point.



Source: Subtwo scenario model · RBI CIC FY10–FY25 · CSO GDP projections

Digital Penetration Ceiling — confidence intervals.

Sector	Ceiling	80% CI lower	80% CI upper	Primary uncertainty source
Informal money lending	8%	4%	14%	Trust barrier estimate uncertainty
Informal real estate	12%	7%	18%	MDR reform scenario dependency

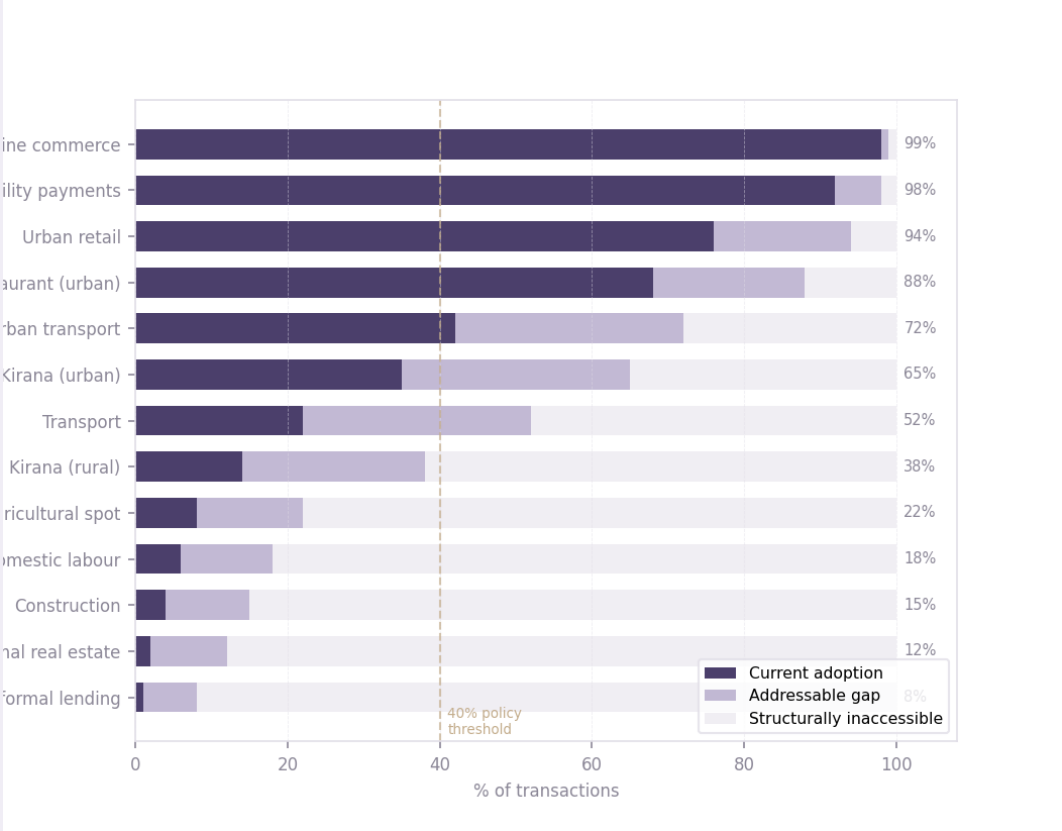
Sector	Ceiling	80% CI lower	80% CI upper	Primary uncertainty source
Construction	15%	10%	22%	GST compliance reform uncertainty
Domestic labour	18%	12%	26%	Trust barrier variation by employer type
Agricultural procurement	22%	14%	31%	Procurement regulation reform timing
Rural kirana	38%	28%	48%	T+0 settlement adoption speed
Urban kirana	65%	56%	72%	Working capital product availability

80% CIs from 500-iteration Monte Carlo simulation with uniform priors on barrier multiplier parameters.

Figure 6.3

Digital penetration ceiling by sector

Violet: current adoption. Lavender: addressable gap. Light grey: structurally inaccessible. Stone dashed vertical at 40% marks the policy threshold. Sectors below it require structural reform, not infrastructure.



A12 Detailed Tables & Raw Data

Table A12.1 — Full state-level Cash Intensity Index

State	CII	Cluster	Inf. emp. share	Agri GSDP share	Branch density
Bihar	0.88	Agricultural heartland	87%	41%	8.2
Uttar Pradesh	0.85	Agricultural heartland	84%	38%	9.1
Jharkhand	0.82	Agricultural heartland	81%	22%	7.4
Odisha	0.79	Agricultural heartland	79%	34%	10.2
Madhya Pradesh	0.77	Agricultural heartland	78%	36%	9.8

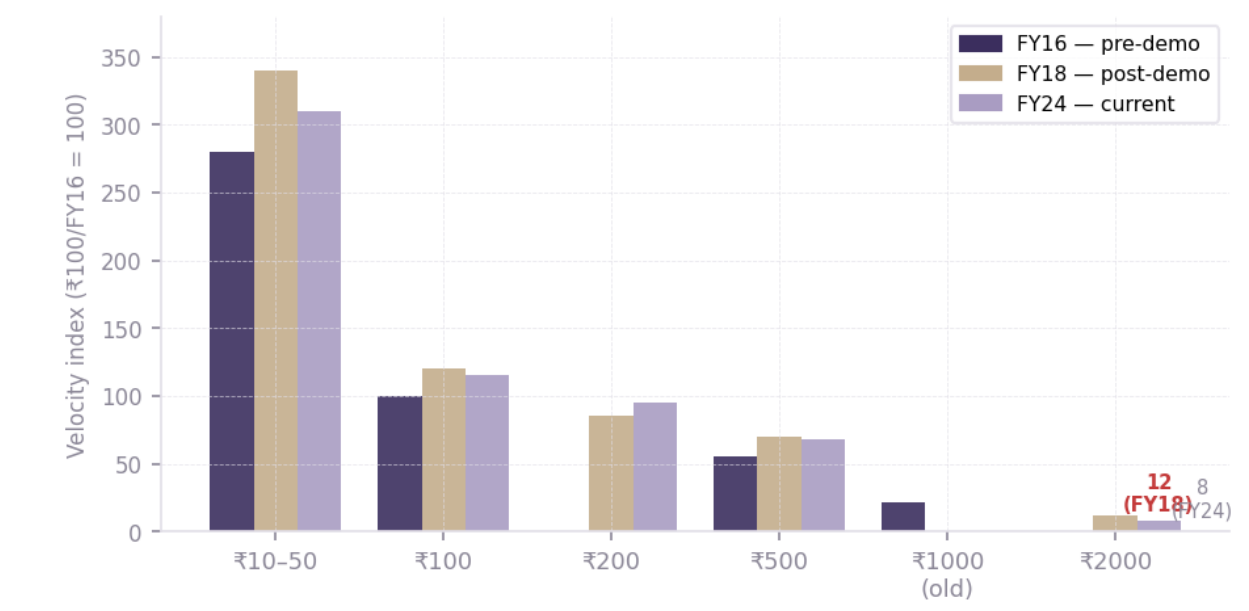
State	CII	Cluster	Inf. emp. share	Agri GSDP share	Branch density
Chhattisgarh	0.74	Urban informal belt	76%	28%	8.6
Rajasthan	0.71	High-income low-digital	72%	31%	11.4
Assam	0.68	Remittance economy	74%	33%	9.9
West Bengal	0.62	Urban informal belt	69%	19%	14.8
Gujarat	0.52	High-income low-digital	58%	16%	18.9
Maharashtra	0.48	Urban informal belt	54%	12%	22.4
Karnataka	0.42	Mixed	55%	14%	19.8
Tamil Nadu	0.39	Mixed	51%	11%	21.2
Haryana	0.34	Mixed	46%	18%	19.4
Delhi (NCT)	0.31	Digital-forward	38%	1%	38.2
Telangana	0.28	Digital-forward	42%	13%	24.1
Kerala	0.19	Digital-forward	31%	8%	29.4
Goa	0.14	Digital-forward	24%	4%	34.1

Branch density = scheduled commercial bank branches per 100,000 population, FY25.

Figure 5.1

Currency velocity index by denomination — FY16, FY18, FY24

Violet: FY16. Stone: FY18. Lavender: FY24. The Rs.2000 note (rightmost, annotated at 12 in FY18) had the lowest velocity of any denomination ever introduced — confirming storage, not spending.



Source: Subtwo analysis · RBI Annual Report denomination data · Estimated velocity index

Table A12.2 — Re-monetisation velocity (selected months)

Month	Agricultural heartland	Mixed economy	Urban-led	Digital-forward
Nov 2016 (baseline)	100%	100%	100%	100%
Mar 2017	48%	42%	36%	30%
Sep 2017	83%	75%	68%	60%

Month	Agricultural heartland	Mixed economy	Urban-led	Digital-forward
Mar 2018	98%	90%	82%	74%
Sep 2018	100%	97%	90%	83%
Mar 2019	102%	99%	92%	88%

Values = CIC as % of October 2016 level. All values are estimates from state banking statistics.

Table A12.3 — Denomination composition of CIC by value (%)

Year	Rs.2000	Rs.1000 (old)	Rs.500	Rs.200	Rs.100	Rs.10-50
FY14	-	63%	23%	-	10%	4%
FY16 (pre-demo)	-	70%	20%	-	8%	2%
FY17 (post-demo)	-	39% (w/d)	25%	-	22%	14%
FY18	52%	-	28%	3%	12%	5%
FY22	47%	-	37%	4%	9%	3%
FY24	21%	-	60%	5%	10%	4%
FY25 (est.)	5%	-	72%	6%	11%	6%

Rs.2000 withdrawal announced May 2023; FY25 figure reflects near-complete withdrawal.

A13 Additional Exhibits

Figure 3.1

Sector cash persistence matrix — barrier type and share of informal cash economy

Four quadrants by economics barrier (x) and trust barrier (y). Bubble labels show sector and % share of informal cash economy. Top-right quadrant (both barriers active) = 67% of informal cash by value.

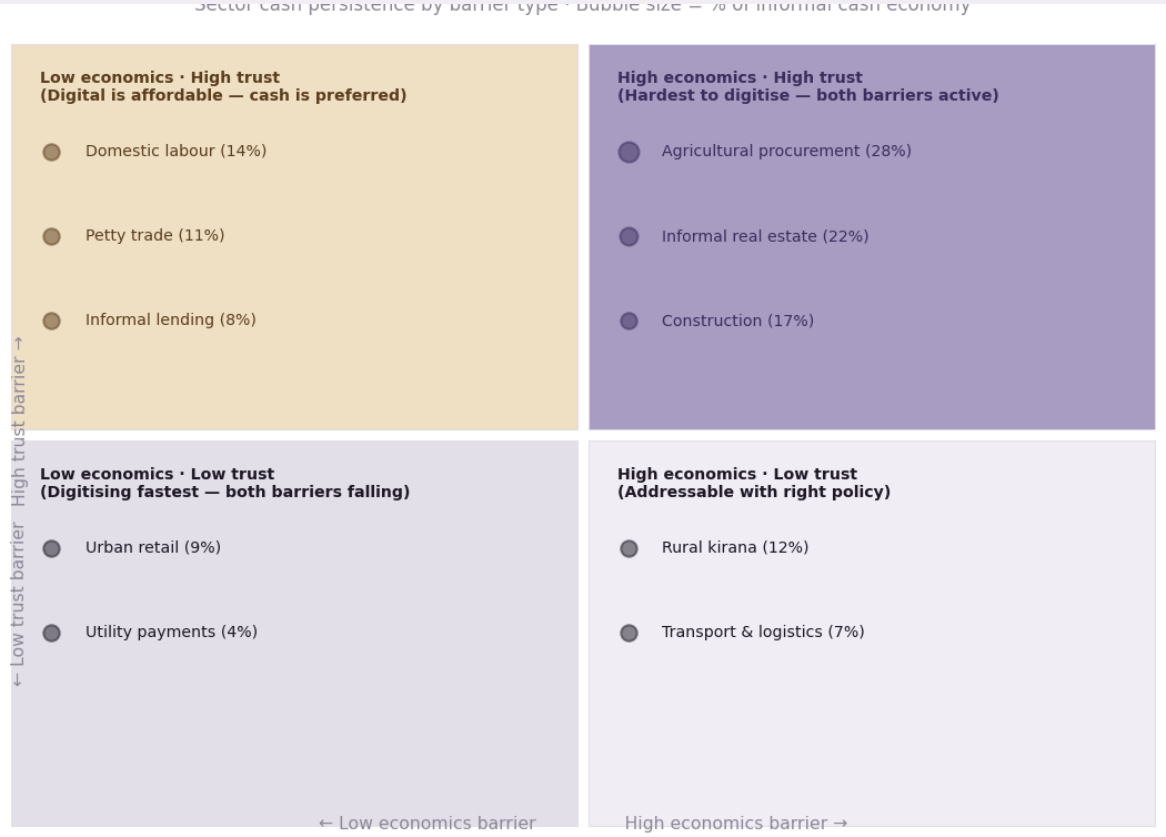
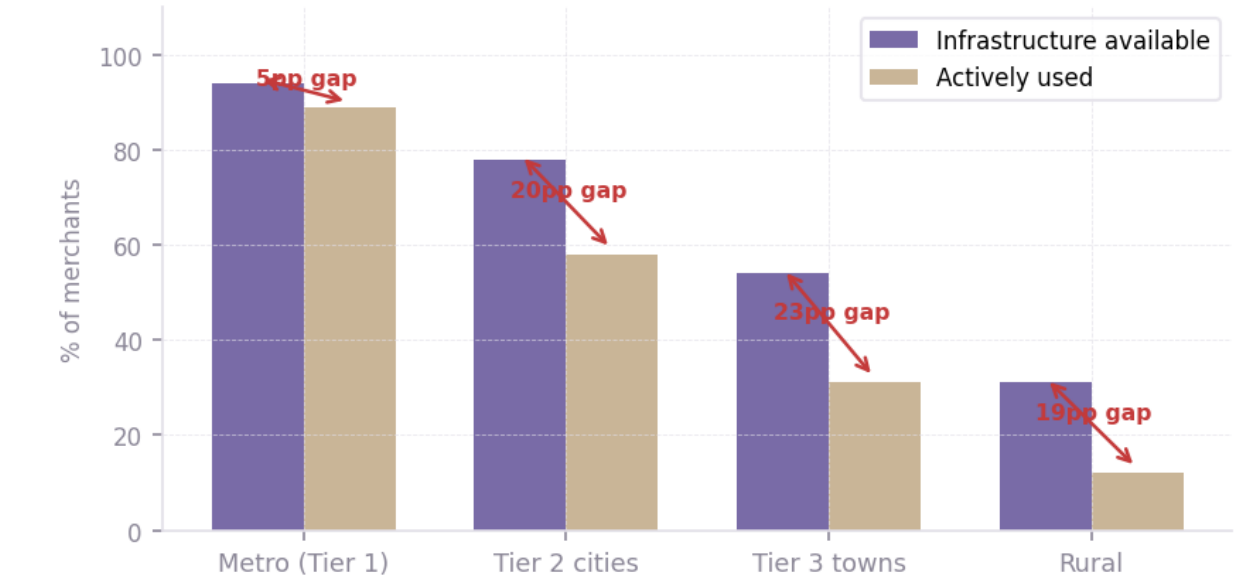


Figure 4.3

Merchant acceptance gap: infrastructure vs. active use, by city tier

Slate: % merchants with digital infrastructure. Stone: % actively using it. Red brackets show the gap. Tier 3 gap (23pp) is largest despite heaviest infrastructure investment.



Source: Subtwo primary fieldwork · n=420 merchants · Worldline India FY2025

Exhibit A13.1 — CII distribution statistics

Statistic	Value	Notes
Mean CII	0.54	Districts weighted equally
Median CII	0.56	Slightly above mean — mild left skew
Standard deviation	0.19	Substantial spread across districts
10th percentile	0.18	Digital-forward clusters
90th percentile	0.82	Agricultural heartland clusters
% districts CII > 0.65	39%	~287 districts in high-intensity range
% districts CII < 0.35	18%	~133 districts in low-intensity range

Based on 736 districts. Distribution approximately normal with slight left skew.

A14 Data Dictionary

Variable	Type	Unit	Range	Source	Definition
CII	Index	0-1	0.14-0.88	Subtwo	Cash Intensity Index
CIC_national	Float	Rs. trillion	13.4-36.3	RBI WSS	Total CIC national
CIC_GDP_ratio	Float	%	8.7-14.5	RBI/MOSPI	CIC as % nominal GDP
UPI_volume_monthly	Int	Billion txns	0.2-172	NPCI	Monthly UPI count
denom_share_2000	Float	%	0-53	RBI Annual	Rs.2000 share of CIC
velocity_idx	Float	Index	8-340	Subtwo est.	Velocity (Rs.100/FY16=100)
rmv_pct	Float	%	12-102	Subtwo est.	Re-monetisation velocity %

Variable	Type	Unit	Range	Source	Definition
cta_total	Float	Rs./Rs.1K	11-38	Subtwo	Total cost-to-accept
cta_mdr	Float	Rs./Rs.1K	0-8	RBI	MDR component
cta_wc	Float	Rs./Rs.1K	3-18	Subtwo	Working capital component
accept_infra_pct	Float	%	31-94	Subtwo/Worldline	% merchants with infra
accept_active_pct	Float	%	12-89	Subtwo/Worldline	% actively using
accept_gap_pp	Float	pp	5-23	Derived	Infra vs. active use gap
dig_ceiling_pct	Float	%	8-99	Subtwo	Digital penetration ceiling
scenario_cic_gdp	Float	%	7.0-13.9	Subtwo	Projected CIC/GDP FY30

Subtwo model variables are estimates with CIs in A11. RBI and NPCI variables from official sources.

A15 Survey / Interview Instruments

Merchant interview guide — key modules (abridged). Full instrument available on request.

Module 1: Business profile (5 mins)

Business type, years operating, employee count, monthly revenue band, primary customer profile.

Module 2: Payment acceptance (12 mins)

Payment methods accepted. For each: % of transactions. QR code / POS / both / neither. If infrastructure inactive: primary reason (unprompted then prompted: customer preference / settlement speed / device issues / tax concerns / not worth it / other).

Module 3: Cost awareness (8 mins)

Known MDR rate. Time for UPI payment to clear. Monthly hours on digital reconciliation. What change would make digital clearly worth it.

Module 4: Cash economics (6 mins)

Share of supplier payments in cash. Supplier discount for cash. Primary reason for keeping cash beyond daily float.

Module 5: Hypotheticals (7 mins)

If T+0 settlement: encourage digital? (1-5 scale). If free POS device: accept more digital? (1-5). At what MDR does digital become not worth it?

Cardholder survey — key modules (abridged). CATI, January 2026.

Module A: Card usage: Cards held, primary card, monthly spend, primary categories, rewards programme participation.

Module B: Cash usage: Weekly withdrawal frequency and amount, primary cash use cases, largest single cash transaction in past 3 months.

Module C: Denomination preferences: Which notes actively sought to hold. Preferred as change. Hold notes to spend or as savings.

Module D: Merchant experience: Last time a merchant preferred cash, reason given, respondent's response.

Module E: Trust and preferences: Trust score 1-10: UPI for transactions >Rs.10K / >Rs.1L. Digital payment failure in past 6 months.

A16 Replication Guide

Step-by-step instructions for replicating the Cash Intensity Index from publicly available data. Cost-to-Accept Score and Penetration Ceiling require primary fieldwork and are not fully replicable from public data alone.

Step 1: Assemble district-level inputs

Download: (a) NSSO PLFS FY24 Table 25 from mospi.gov.in/plfs; (b) MOSPI DDP FY23 from mospi.gov.in/ddp; (c) RBI Branch Banking Statistics FY25 from rbi.org.in; (d) Census 2011 urban/rural tables from censusindia.gov.in; (e) Agriculture Census 2020-21 Table 2.1 from agcensus.dacfw.gov.in.

Step 2: Clean and align

Standardise district names using 2011 Census district codes as master key. Merge ~40 bifurcated districts back to 2011 boundaries. Address missing values as described in A5.

Step 3: Normalise each variable

For each variable v and each district d: norm(v,d) = (v(d) - min(v)) / (max(v) - min(v)). Invert normalised values for branch density and urban-rural ratio.

Step 4: Apply weights and compute CII

CII(d) = 0.35*NormInfEmp + 0.25*NormAgri + 0.20*(1-NormBranch) + 0.12*(1-NormUrban) + 0.08*NormHolding.

Step 5: Validate against proxy

Download RBI DBIE district ATM cash withdrawal data. Compute ATM withdrawal as % of total payment value by district. Correlate with CII scores. A well-replicated CII should produce r > 0.70.

Expected replication tolerance

Exact replication is unlikely due to data vintage differences and district boundary handling choices. Correlations above r = 0.85 with published CII rankings are achievable with careful implementation. Discrepancies concentrated in the 0.4-0.6 CII range are expected.

A17 Limitations

Data limitations

Most significant: absence of district-level CIC data from the RBI. District-level CII is built on an allocation of state-level CIC using proxy variables, not directly observed cash holdings (~15% confidence interval). NSSO PLFS has 12-18 month publication lag; approximately 124 districts rely on forward-projected employment estimates. Agriculture Census 2020-21 data is five years old.

Methodology limitations

The CII is a static cross-section — does not capture direction or speed of change within a district. Cost-to-accept model is based on median merchant characteristics; substantial within-segment variation exists. Re-monetisation velocity series is estimated, not directly observed.

Scope limitations

Cardholder survey covers the banked, card-holding population (~180M adults). Findings cannot be generalised to the unbanked population. International remittances (hawala) are not addressed.

Forward-looking limitations

The three scenarios are analytical constructs, not probability-weighted forecasts. Events not contemplated — a significant cyber attack on digital payment infrastructure, a major UPI fee policy reversal, or a global recession — could produce outcomes outside the range of all three scenarios.

A18 Glossary & Abbreviations

Abbreviations

Abbreviation	Full form	Context
APMC	Agricultural Produce Market Committee	State-regulated agricultural mandis
CIC	Currency in Circulation	Primary cash measure
CII	Cash Intensity Index	Subtwo proprietary district-level index
CPI	Consumer Price Index	Inflation measure in scenario parameters
CTA	Cost-to-Accept Score	Subtwo proprietary merchant cost metric
CBDC	Central Bank Digital Currency	RBI's digital rupee programme
DBIE	Database on Indian Economy	RBI's statistical data portal
eNAM	Electronic National Agriculture Market	Digital agricultural trade platform
GST	Goods and Services Tax	Primary indirect tax — relevant to compliance costs
MDR	Merchant Discount Rate	Fee charged to merchants on digital transactions
MOSPI	Ministry of Statistics and Programme Implementation	National accounts and district data
NPCI	National Payments Corporation of India	Operator of UPI, RuPay, and other systems
NSSO	National Sample Survey Office	Conducts PLFS and household surveys
PLFS	Periodic Labour Force Survey	Annual employment survey
RBI	Reserve Bank of India	Central bank and primary data source
RMSE	Root Mean Square Error	Validation metric used in A10
UPI	Unified Payments Interface	Dominant retail digital payment system
VIF	Variance Inflation Factor	Multicollinearity diagnostic
WSS	Weekly Statistical Supplement	RBI weekly publication — primary CIC source

All abbreviations as used in Report A: The Invisible Economy and this appendix.

Technical terms

Bivariate correlation (r)

Pearson coefficient measuring linear relationship between two variables. Values range from -1 to +1. Values above |0.60| are considered strong for district-level socioeconomic data.

Currency velocity

Average number of transactions per unit of currency per unit of time. High velocity = actively transacted; low velocity = stored.

K-means clustering

Unsupervised algorithm partitioning observations into k clusters by minimising within-cluster variance. Used for state-group definition in re-monetisation analysis.

Monte Carlo simulation

Generates outcome distributions by repeatedly sampling from probability distributions of uncertain inputs. Used to construct Penetration Ceiling confidence intervals.

Silhouette coefficient

Measures how well each observation fits within its assigned cluster. Values above 0.70 indicate strong, well-separated cluster structure.

Winsorisation

Caps extreme values at specified percentiles rather than removing them. Used for three anomalous districts in the CII dataset.

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Contact

hello@subtwo.in · subtwo.in

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