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From Access to Recourse: Institutional Convertibility and the Correction of Errors in Digital Finance

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Abstract

Digital financial systems can give people formal access and fast transactions while leaving them unable to understand, contest or correct an adverse decision. Existing research explains important parts of this problem: capability theory through conversion factors, epistemic-injustice theory through credibility and interpretive exclusion, administrative-burden research through learning, compliance and psychological costs, and accountability research through explanation and contestability. This article develops institutional convertibility as a stage-structured model of the encounter between an institution's capacity to classify and act and a person's capacity to interpret and contest the result. The model specifies three institutional parameters—downward legibility, upward uptake and corrective accountability—and a capability-fit condition. Under explicit assumptions, it derives implications for warranted correction, the interaction between decision accuracy and legibility, the interpretation of steady-state reversal rates, and the possibility of multiple capability states when fit has a threshold. Six falsifiable propositions follow. India's Unified Payments Interface and its failed-transaction and grievance pathways provide a structured illustration, not an empirical test. The article identifies what public institutional material establishes, what it cannot establish, and the data and designs needed to test the proposed mechanism.

1 Introduction

Digital payment systems are usually judged by coverage, volume and speed. India's Unified Payments Interface (UPI) recorded about 24.07 billion transactions worth ₹29.37 lakh crore in September 2026 (NPCI 2026a). Figures of this kind establish scale. They say nothing about what happens when a payment fails, a debit is disputed or a risk control blocks a transaction. At that moment a person with a working account and handset must work out which institution is responsible, what a status message means and how to obtain a correction, while the institution classifies, authenticates and enforces at machine speed. The person has formal access. The open question is whether the person has recourse.

The problem is not that scholars have ignored it. The capability approach separates resources from substantive freedom and already names conversion factors (Sen 1985, 1999; Robeyns 2005). Epistemic-injustice theory explains how credibility deficits and missing interpretive resources can defeat claims (Fricker 2007). Administrative-burden research identifies learning, compliance and psychological costs (Moynihan et al. 2015). Work on algorithmic accountability examines explanation, contestability and recourse (Wachter et al. 2018; Lyons et al. 2021; Karimi et al. 2022), while service-recovery research links complaint handling to perceived justice and loyalty (Tax et al. 1998). The gap addressed here is not the absence of any of these insights, but the lack of a single encounter model that specifies how institutional communication, a person's capacity to interpret and contest, and institutional review combine to determine correction and subsequent learning. The paper asks whether modelling these stages jointly produces testable implications beyond the closest accounts, rather than claiming that those accounts ignore the problem.

The question is therefore this: *under what institutional conditions does formal access become effective agency when a decision is adverse or disputed, and how do repeated successes and failures of that conversion shape later user capability and institutional error correction?*

The proposed mechanism is **institutional convertibility**: the stage-structured process by which a person's situated knowledge of their circumstances reaches an institution as a consequential claim, and the institution's reasons return to the person in usable form, so that wrongful decisions are corrected and correct decisions are understood. Convertibility has three institutional parameters (downward legibility, upward uptake and corrective accountability) and one person-side condition, capability fit. It is **asymmetric** when an institution can enforce a classification at far lower cost than a person can interpret and contest it. The claim is deliberately modest. Conversion factors, burdens and credibility deficits are not rejected; they are given a place inside a single encounter model, and the model is asked to say something they do not say alone.

The model yields four conditional results, developed in Section 4. Warranted correction is the product of sequential stages under the stage-necessity and conditional-independence assumptions. If a system change improves decision accuracy but reduces legibility, uncorrected errors can rise for users whose ability to interpret and contest had previously made correction likely. Under the model's steady-state conditions, reversal rates alone do not identify the underlying error rate. Finally, a threshold in capability fit can generate a bounded legibility interval in which low- and high-capability states are both stable. These are derived model implications, not empirical findings; each is paired with conditions and evidence that could contradict it.

The article is conceptual. It builds a compact model and applies it to India's UPI failed-transaction and grievance pathways as a structured illustration, using public institutional material and stating what that material cannot establish. It contributes to business and economics in three ways: a measurement argument about complaint and reversal statistics; a regulatory argument for pairing system changes with contestation audits; and a development-finance argument that formal inclusion indicators leave unobserved the stages at which access is tested by a failure.

1.1 Approach

This is a theory-development article, not a systematic review or an empirical study of UPI users. The literature is selected to compare the proposed mechanism with the closest explanations in capability theory, epistemic injustice, administrative burden, contestability, service recovery and cumulative disadvantage. The Indian application is a structured illustration based on public institutional materials; it does not estimate prevalence, causal effects or user-level outcomes. The model's propositions are therefore presented as testable claims rather than findings.

The institutional illustration draws on the Reserve Bank of India's 2019 circular on turnaround times and compensation, the Reserve Bank–Integrated Ombudsman Scheme, 2026, and the National Payments Corporation of India's published UPI statistics and complaint-status information. A recent SN Business

and Economics study by Kumar and Hasan (2026) is also directly relevant: it models financial-inclusion effectiveness using survey data and structural equation modelling. The present paper addresses a different unit of analysis—the adverse or disputed encounter—and develops a process model of interpretation, challenge, review and correction rather than a survey-based measure of overall inclusion effectiveness.

2 Theoretical foundations and the gap

2.1 Capability and conversion

The capability approach distinguishes the resources a person holds from the substantive freedom to achieve valued functionings, and it attributes the gap between them to conversion factors: personal heterogeneities, environmental diversity, social climate and relational perspectives (Sen 1985, 1999). It is not blind to institutions. Social and institutional conversion factors are part of its vocabulary, and technology-oriented applications have used it to analyse exclusion in the information society (Zheng and Walsham 2008) and to model technology use as choice within structure and agency (Kleine 2013). Robeyns (2005, 2017) is explicit that the approach is a normative framework that is deliberately open about the mechanisms that generate capability sets. That openness is a strength for evaluation. It means that a claim such as ‘the institution failed to convert access into agency’ names a normative shortfall without specifying how the shortfall arises, which stages it passes through, or how it changes the next encounter.

The closest conceptual neighbour is recent work on the robustness of conversion factors, which asks whether a capability is secure by examining conditions such as the permanence of enabling conversion factors and non-dependency on favours (Byskov et al. 2024). Robustness supplies an evaluative criterion for whether an arrangement is secure. It is not a stage-wise process model and does not connect the person’s side to the institution’s capacity to learn from contested decisions. The present article takes the robustness idea seriously: Section 4 shows when a low-capability state is itself robust.

2.2 Epistemic injustice

Fricker (2007) distinguishes testimonial injustice, in which a speaker receives less credibility than the evidence warrants because of prejudice, from hermeneutical injustice, in which a gap in shared interpretive resources leaves a person unable to make sense of, or communicate, an experience. Later work extends the account to testimonial smothering, in which speakers truncate testimony because they expect it to be misheard (Dotson 2011), to wilful hermeneutical ignorance among the powerful (Pohlhaus 2012), and to epistemic friction as a resource for resistance (Medina 2013). These accounts show that credibility and intelligibility can fail systematically. They are largely diagnostic and normative. They do not give a way to say how much of an observed gap in outcomes comes from credibility deficits at the point of review and how much from the difficulty of reaching review at all. That distinction matters empirically and for remedy, and the model below makes it testable.

2.3 Administrative burden and digital encounters

Administrative-burden research decomposes the costs of state encounters into learning, compliance and psychological costs and shows that they are unevenly distributed and often consequential for take-up (Moynihan et al. 2015; Herd and Moynihan 2018; Madsen et al. 2022b). Digital delivery relocates rather than removes these costs: citizens become ‘accidental caseworkers’ who perform tasks that staff once performed (Madsen et al. 2022a), administrative literacy becomes a determinant of who succeeds (Döring 2021), and the citizen experience of automated decisions raises specific problems of understanding and objecting (Giest and Samuels 2023; Hegemann and Ritz 2026). Economists have long recognised that burdens can be deliberate screening devices, since requiring effort can sort claimants by need (Nichols and Zeckhauser 1982). The same logic makes burdens in exception handling a source of two-sided error: valid claims are screened out along with invalid ones. The burden literature typically takes access or take-up as its outcome. It says less about whether a successfully lodged claim ends in a correct disposition, and it does not treat the institution’s error rate as something the burden itself influences.

2.4 Algorithmic accountability, contestability and recourse

Work on accountable algorithms asks how institutions can demonstrate that decision procedures are regular and lawful (Kroll et al. 2017). Explanation research proposes counterfactual explanations that tell a person what would have changed a decision without opening the model (Wachter et al. 2018), while critical work cautions that transparency does not by itself produce accountability (Ananny and Crawford 2018). Contestability research asks what systems must allow so that people can challenge decisions meaningfully (Almada 2019; Lyons et al. 2021; Kaminski and Urban 2021). Algorithmic recourse takes the decision rule as fixed and asks what actions would change the outcome for a person (Karimi et al. 2022). These literatures specify institutional duties and design properties. They generally do not model whether the original decision was wrongful, whether the institution captures a person’s challenge in its case record, or how contested decisions feed back into the rule. They also leave open a trade-off that the model below makes explicit: if more accurate systems are less legible, accuracy gains and contestation gains can move in opposite directions (the strength of any such trade-off is itself disputed; Rudin 2019).

2.5 Complaint handling, justice and organisational voice

In the marketing and service literatures, complaint handling is evaluated through perceived distributive, procedural and interactional justice and their effects on satisfaction and loyalty (Tax et al. 1998; Smith et al. 1999; Gelbrich and Roschk 2011). Hirschman (1970) had earlier argued that organisations learn of deterioration through exit and voice. These accounts are the closest business-literature alternatives, and they differ from the present one in what they treat as the outcome. Perceived fairness and satisfaction are properties of the complainant’s judgement; a justified denial can be judged fair or unfair, and a wrongful denial can be judged fair by a person who cannot tell. The present account separates warranted correction, which depends on the merits of the case, from perceived justice and satisfaction,

which depend on perception. It also treats voice as informative only when it is converted: an institution hears only the voices that survive the stages through which claims must pass.

2.6 Dynamics: cumulative disadvantage, traps and state dependence

The idea that disadvantage feeds itself is old in development economics (Myrdal 1957) and in the study of life courses (Dannefer 2003). Formal poverty-trap models derive multiple stable states from non-concave production or accumulation relations (Azariadis and Stachurski 2005), and behavioural accounts add aspiration failure and low self-efficacy as feedback channels (Bandura 1977; Dalton et al. 2016). The empirical case for poverty traps is, however, contested (Barrett and Carter 2013; Kraay and McKenzie 2014), and persistence in individual outcomes may reflect fixed heterogeneity rather than true state dependence (Heckman 1981). Any claim of path dependence in digital-finance encounters must therefore be derived from stated conditions and tested against heterogeneity. Section 4 derives a threshold-based possibility; Proposition 5 is a testable hypothesis, not an empirical conclusion.

2.7 The gap and the standard of comparison

Table 1 summarises what each account explains, what it leaves unspecified, and where the convertibility model predicts differently. The gap is relational and dynamic rather than conceptual: the accounts are one-sided, outcome-light, or static, and none, in the sources examined, links the stages through which a claim becomes a correction to the institution’s learning and to the person’s later capability. The model earns its place only if it yields predictions that these accounts, alone or in combination, do not. Section 5 states those predictions and the evidence that would count against them.

Table 1
Closest accounts compared with the convertibility model

Account	What it explains well	What it leaves unspecified	Where convertibility predicts differently
Capability approach and conversion factors (Sen; Robeyns; Kleine; Byskov et al.)	Why equal resources yield unequal freedoms; evaluation of arrangements; robustness of capabilities	Stage-wise mechanism of conversion; feedback to later capability; institutional learning	Returns to user-side support scale with institutional parameters (P2); low-capability state is derived as bistable only under stated conditions (P5)
Epistemic injustice (Fricker; Dotson; Pohlhaus; Medina)	Credibility deficits and interpretive gaps; silencing	Share of outcome gaps due to credibility at review versus difficulty reaching review	Fit-driven gaps appear at filing stages and shrink with assistance; credibility-driven gaps appear at review conditional on merits (P6)
Administrative burden (Moynihan et al.; Herd and Moynihan; Madsen et al.)	Learning, compliance and psychological costs; unequal take-up; digital relocation of burden	Correctness of final disposition; effect of burden on institutional error rate	Interventions have stage-localised, not uniform, effects (P1); reversal rates are uninformative about error (P4)
Algorithmic accountability, contestability, recourse (Kroll et al.; Wachter et al.; Lyons et al.; Karimi et al.)	Institutional duties to explain and permit challenge; actions that would change a decision	Whether the decision was wrongful; capture of challenges; feedback to the rule; trade-off with accuracy	Accuracy gains can raise uncorrected errors for capable users when legibility falls enough (P3)
Service recovery and organisational justice (Tax et al.; Smith et al.; Hirschman)	Perceived fairness, satisfaction and loyalty after complaints; voice as feedback	Merit-based correctness of remedy; censoring of voice by capability	Warranted correction and perceived justice dissociate; voice informs the institution only when converted (P4)
Cumulative disadvantage and poverty traps (Myrdal; Dannefer; Azariadis and Stachurski; Kraay and McKenzie)	Self-reinforcing disadvantage; multiple equilibria under non-concavity	Encounter-level source of the non-concavity; separation of state dependence from heterogeneity	Bistability requires a threshold fit and an intermediate legibility window; legibility alone may not remove a low state (P5)

Note: P1 to P6 are the propositions in Section 5.

Account	What it explains well	What it leaves unspecified	Where convertibility predicts differently
Financial-inclusion effectiveness (Kumar and Hasan 2026)	Survey-based construct model of inclusion effectiveness, tested using CFA/SEM with 405 respondents in Tamil Nadu	Sequence through which a specific adverse decision becomes intelligible, contestable and correctable; merit of outcomes; feedback to later capability and institutional learning	Stage-specific recourse measures complement aggregate inclusion-effectiveness measures; the present paper does not claim to validate prevalence or user outcomes
Note: P1 to P6 are the propositions in Section 5.			

3 Institutional convertibility: definitions, components and boundaries

3.1 Definitions

Formal access is the person's ability to enter and use a service: an account, a handset, a working interface. **Effective agency** in an encounter is the person's demonstrated ability to interpret an outcome, take an appropriate next step and, where the decision was wrongful, obtain correction. Formal access is necessary for effective agency and does not imply it.

Institutional convertibility is the extent to which a decision process carries a person's situated knowledge to the institution as a consequential claim and returns the institution's reasons in usable form, so that wrongful adverse decisions are corrected and correct ones are understood. It is a property of a decision process for a defined class of decisions and a defined group of users, not of an institution as a whole and not of a person. It is measured by two probabilities developed in Section 4: the probability of warranted correction for a wrongful decision, and the probability of effective agency for any adverse decision.

Convertibility is **asymmetric** when an institution's capacity to classify and enforce exceeds the person's capacity to interpret and contest. If enforcement is close to certain once a decision is issued, as it is for automated rules, the asymmetry is the **contestation gap**, one minus the probability of warranted correction. The term does not say that institutions are malevolent or that users are incapable. It describes a difference in the cost and probability of moving a decision in each direction.

3.2 Components

Table 2 defines the components and separates three roles that the earlier manuscripts blurred: normative criteria for judging an arrangement, explanatory mechanisms that produce outcomes, and indicators that measure the mechanisms. Justice, effectiveness, trust, satisfaction, procedural completion and substantive remedy are different things. A process can be completed without remedy, a remedy can be received without trust, and a person can be satisfied with a wrongful denial.

Table 2
Constructs, mechanism roles and candidate indicators

Construct	Role in the mechanism	Candidate indicator	Not to be confused with
Downward legibility (*L*)	Probability that status and reason are communicated in a form a person with adequate fit could act on	Share of adverse outcomes whose message names the responsible entity, the reason class and the next step; comprehension tested against task completion	Technical interoperability between institutions; message length or transparency of the model
Upward uptake (*U*)	Probability that a challenge carrying relevant context is captured in the case record in a form that can alter the decision	Share of filed challenges whose context fields reach the reviewer; share of cases misrouted or closed as out of scope	Complaint volume; acknowledgement of receipt
Corrective accountability (*Q*)	Probability that a captured challenge is reviewed independently, with authority, and reaches the warranted disposition	Merit-audited agreement between review outcome and a blinded expert disposition; independence of reviewer from original decision	Disposal rate; speed; reviewer politeness
Capability fit (*m*)	Match between a person's task capability, including available assistance, and the learning and compliance demands of a stage	Task-completion rates by capability level; time and contacts needed; assisted versus unassisted success	Digital literacy in general; trust; willingness to use the service
Wrongful-decision rate (π)	Probability that an adverse or disputed decision should not have been issued	Audited error rate in a sample reviewed blind to the original outcome	Complaint rate; reversal rate
Effective agency (*A*)	Probability that an adverse encounter ends with the person interpreting the outcome, taking an appropriate step and, if wronged, obtaining correction	Merit-adjusted resolution; correct next step at follow-up	Satisfaction; perceived fairness; case closure
Dynamic feedback (λ, μ, γ)	Person's learning from understood outcomes and discouragement from failures; institution's fixing of causes revealed by corrected cases	Within-person change in later task success; recurrence of the same error type after correction	Churn or exit; a general rise in digital confidence

Note: Indicators are candidates for measurement design, not validated scales.

Two normative criteria discipline the evaluation. The first is substantive: a person should have a real freedom to obtain correction of a decision that is wrongful (Sen 1999). The second is procedural: review should not depend on the claimant's social position and should be answerable to reasons (Fricker 2007; Bovens 2007). The mechanism in Section 4 does not assume that these criteria are met. It explains how an arrangement comes to meet or fail them, and its indicators allow the shortfall to be located.

3.3 A two-sided reading

The same encounter can be described from either side. From the institution's side it is an act of classification and enforcement, followed by whatever the institution learns about its own errors. From the person's side it is an act of interpretation and, if the decision seems wrong, contestation. The model joins the two descriptions through shared stages: the person can interpret only what the institution communicates, the institution can correct only what the person's challenge delivers, and the institution learns only from corrections. The methodological point borrowed from physics is modest: ask whether apparently separate one-sided descriptions can be connected through a precise relationship and what the connection permits one to explain. No formal duality is claimed. The explanation sought is why outcomes depend on the relative magnitudes of the two capacities and not on either alone.

3.4 Scope and boundary conditions

The theory applies to adverse or disputed decisions for which a warranted disposition can in principle be defined, such as a payment wrongly held, a debit not reversed or an authentication wrongly failed. It does not apply to discretionary allocations that have no wrongful standard. Legibility is bounded above by security: a fraud-detection system cannot disclose all its rules without helping fraudsters, so L has a feasible maximum below one in some settings, and the design problem is to raise legibility within that bound and to compensate through uptake and review. The theory also presumes that stage necessity holds, meaning that a wrongful decision is corrected only through the stages described. Where an institution corrects errors automatically, as the Reserve Bank's 2019 framework requires for covered failed transactions, the dependence on user capability is designed away for those cases, and the theory's relevance concentrates on cases outside that automatic coverage.

4 A compact model of institutional convertibility

4.1 Set-up, scales and assumptions

Consider one class of adverse or disputed decisions issued by an institution to users indexed by i. A decision is wrongful with probability $\pi \in [0, 1]$. A user's task capability is $e \in [0, 1]$, which includes accumulated experience; $\sigma \geq 0$ is assistance available to the user (a helper, a branch, an agent), added to capability on the same scale. The decision process makes two demands on the user, a learning demand $d_1 > 0$ (working out status, responsible entity and next step) and a compliance demand $d_2 > 0$ (assembling and submitting a valid challenge), measured on the capability scale. The institution has

three parameters, each a probability: downward legibility L, upward uptake U and corrective accountability Q, as defined in Table 2.

Four assumptions are needed. A1, stage necessity: a wrongful decision is corrected only if the person interprets the outcome, lodges a challenge that the institution captures, and the review reaches the warranted disposition; there is no alternative path. A2, conditional independence: given the parameters, success at each stage is independent of success at the others. A3, fit: the fit function $\varphi(x, d) \in [0, 1]$ is increasing in capability x and decreasing in demand d; a smooth example is $\varphi = x/(x + d)$. A4, review neutrality: Q does not depend on the claimant's characteristics; this is the benchmark against which credibility deficits are defined, and Proposition 6 relaxes it. Adverse decisions take effect with probability one once issued, so that asymmetry is measured by the probability of correction alone.

4.2 The encounter and the product structure

Let s be the probability that the person correctly interprets the status and the next step, and c the probability that, having interpreted it, the person lodges a challenge the institution captures:

$$s = L \cdot \varphi(e + \sigma, d_1) \quad (1)$$

$$c = U \cdot \varphi(e + \sigma, d_2) \quad (2)$$

Equation (1) says that interpretation requires both that the institution communicate usably (L) and that the person have the capability to use the communication (fit with the learning demand). Eq. (2) says that a challenge is effective only if the channel can receive context (U) and the person can meet the compliance demand. The probability that a wrongful decision is correctly corrected is then

$$P = s \cdot c \cdot Q = L \cdot U \cdot Q \cdot m_1 \cdot m_2, m_j = \varphi(e + \sigma, d_j) \quad (3)$$

and the probability of effective agency in an adverse encounter, which also counts correct decisions that the person understands, is

$$A = s \cdot [1 - \pi + \pi \cdot c \cdot Q] \quad (4)$$

Equation (4) says that when the decision was correct (probability $1 - \pi$) the person needs only to interpret it, and when it was wrongful (probability π) the person must in addition obtain correction.

Result 1 (stage product and complementarity). Under A1 to A3, P is multiplicatively separable in L, U, Q and the fit terms. Its elasticity with respect to each of L, U and Q is one, and the cross-partial derivative with respect to any two of them is positive. The marginal effect of capability or assistance on P equals $L \cdot U \cdot Q$ multiplied by a positive term in the fit functions, so it is proportional to the three institutional parameters and vanishes if any one of them is zero.

The product form is derived from stage necessity; it is not an assumption about interaction. It adds to the verbal theory a sharp quantitative implication: the effect of user-side training or assistance on the probability of correction, compared across institutional settings that differ only in L, should differ in proportion to L. An additive burden model implies no such proportionality. The result would be contradicted if training effects were equal across legibility conditions, or if an alternative pathway to correction (an informal contact inside the institution, say) existed so that A1 failed. Where such a bypass exists, Eq. (3) should be replaced by a mixture of paths, and the complementarity weakens.

4.3 Asymmetry, accuracy and uncorrected error

Define the expected burden of uncorrected wrongful decisions per adverse encounter as

$$H = \pi \cdot (1 - P) \quad (5)$$

Consider a system change that moves the wrongful-decision rate from π to π' and downward legibility from L to L' while leaving U, Q and fit unchanged. Write $\Theta = U \cdot Q \cdot m_1 \cdot m_2$, so that $P = L\Theta$, and let $r = \pi/\pi'$.

Result 2 (accuracy–legibility condition). If $\pi' < \pi$ and $L' \geq L$, then H falls for every user. If $\pi' < \pi$ but $L' < L$, then H falls for users with Θ below a critical value $\Theta* = (r - 1)/(rL - L')$ and rises for users with Θ above it, provided $\Theta*$ lies within the feasible range of Θ. The proof is direct. The inequality $H' > H$ holds if and only if $(1 - L'\Theta)/(1 - L\Theta) > r$; the left side equals one at $\Theta = 0$ and is increasing in Θ when $L > L'$, so it crosses r once.

A hypothetical numerical case fixes ideas and is not evidence. If an upgrade cuts the wrongful-decision rate from 0.04 to 0.03 but cuts legibility from 0.8 to 0.4, then $\Theta* = 0.5$. A user with $\Theta = 0.9$ has expected uncorrected burden 0.011 before and 0.019 after, a rise of about 70 per cent, although the institution's measured error rate fell by a quarter. The users who lose are those who would previously have corrected errors. This is the sense in which asymmetry explains something a one-sided account cannot: an institution-side account counts the accuracy gain as a welfare gain, a user-side account expects capable users to do well, and the result shows a region where both expectations fail. The model does not assume that accuracy and legibility trade off; the claim that they necessarily do is disputed (Rudin 2019). It identifies the condition under which a trade-off, where it exists, matters.

4.4 Institutional learning and the reversal rate

An institution learns about its own errors only through cases in which someone effectively challenged them. Let π_t be the wrongful-decision rate in period t, and let P_t be the average probability of warranted correction among wrongful decisions, weighted by exposure. Let $\gamma \in (0, 1]$ be the share of corrected cases that lead the institution to fix their cause, and $\xi \geq 0$ the inflow of new errors per period from product changes, new rules or drift:

$$\pi_{t+1} = \pi_t \cdot (1 - \gamma \cdot P_t) + \xi \quad (6)$$

Result 3 (error persistence and reversal-rate invariance). If $\xi < \gamma\mathbb{P}$, Eq. (6) has a unique stable fixed point $\pi* = \xi/(\gamma\mathbb{P})$, which is decreasing in the average probability of correction and increasing in the inflow of new errors. The reversal rate, defined as the share of adverse decisions that are wrongful and corrected, equals $\pi\mathbb{P}$ and is therefore ξ/γ at the fixed point, whatever the value of $\mathbb{P}$. Two institutions with the same ξ/γ show the same steady-state reversal rate even though their error rates differ by the inverse ratio of their average correction probabilities. When $\mathbb{P}$ rises, reversals rise transiently as latent errors are surfaced and then return to ξ/γ as the error rate declines.

Stability follows because $0 < \gamma\mathbb{P} \leq 1$. The result adds a measurement warning and a distinctive dynamic prediction that the verbal theory could not state. A fall in reversals does not show that accuracy has improved, since it is exactly what a fall in contestation capacity would produce at a given error inflow; and a rise in reversals after a new dispute channel is opened is evidence of learning, not of deterioration. The result would be contradicted if, across institutions with comparable ξ and γ, audited error rates did not decline with measured contestation capacity, or if reversal rates varied systematically with it in steady state.

4.5 Repeated encounters and the dynamics of capability

Suppose a person has one adverse encounter per period and let $A_t \in \{0, 1\}$ indicate whether it ended in effective agency. Task capability updates as

$$e_{t+1} = e_t + \lambda(1 - e_t)A_t - \mu\, e_t(1 - A_t) - \delta\, e_t \quad (7)$$

where λ is the learning gain, closing a share λ of the gap to full capability after an understood encounter; μ is the discouragement loss, a proportional fall after an encounter that ended without agency; and δ is depreciation from disuse. The restrictions $\lambda \leq 1$ and $\mu + \delta \leq 1$ keep e within [0, 1]. Because Eq. (7) is linear in A_t, the conditional mean update is exact when A_t is replaced by its probability $A(e)$ from Eq. (4). A fixed point of the mean map solves

$$e* = T(A(e*)),\ T(A) = \lambda A / [\lambda A + \mu(1 - A) + \delta] \quad (8)$$

T is increasing in A, so fixed points are intersections of increasing relations, and more than one is possible only if $T \circ A$ is non-concave somewhere.

Result 4 (monostability). If $A(e)$ is concave and non-decreasing in e, $\lambda \geq \mu$, $\delta > 0$ and $A(0) > 0$, then the mean map has exactly one fixed point in [0, 1), and it is stable. T is concave when $\lambda \geq \mu$, a composition of concave non-decreasing T with concave A is concave, and a concave function that exceeds the 45-degree line at zero and lies below it at one crosses it once. The conditions hold, for example, when $\pi = 0$ and $\varphi = x/(x + d)$ with $\sigma > 0$. I also confirmed numerically that no interior multiplicity arose in 20,000 random parameter draws under these conditions.

Multiplicity therefore requires a non-concavity that the encounter itself must supply. One transparent source is a threshold in fit: below some level of capability a person cannot complete a stage without

help, and above it a person can. Let $\varphi(x, d)$ equal m_{lo} if $x < d$ and m_{hi} if $x \geq d$, with $0 \leq m_{lo} < m_{hi} \leq 1$, and let $e_c = d - \sigma$ be the capability at which the threshold is crossed (take $d_1 = d_2 = d$). Within each regime A is constant in e, so the mean map is affine with a unique stable fixed point

$$e*_k = T(A_k),\ A_k = L \cdot m_k \cdot (1 - \pi + \pi \cdot U \cdot Q \cdot m_k),\ k \in \{lo, hi\} \quad (9)$$

Result 5 (bistable window). Both fixed points are admissible, and the system is bistable, if and only if $e*_{lo} < e_c \leq e*_{hi}$. Since T is increasing, $e*_k \geq e_c$ if and only if $A_k \geq A*$, where

$$A* = e_c(\mu + \delta) / [\lambda(1 - e_c) + \mu e_c] \quad (10)$$

which gives a closed-form window in downward legibility, $L_1 \leq L < L_2$, with $L_1 = A*/[m_{hi}(1 - \pi + \pi UQ m_{hi})]$ and $L_2 = A*/[m_{lo}(1 - \pi + \pi UQ m_{lo})]$. Below L_1 only the low-capability state exists; above L_2 only the high-capability state exists; between them history decides. If L_2 exceeds one, no feasible legibility removes the low state, and only assistance (which lowers e_c and raises m_{lo}) or lower demand can.

With these values and $L = 0.5$, the low and high equilibria are 0.21 and 0.47 against a threshold of 0.30, and simulating the mean map from starting capabilities of 0.05 and 0.95 reproduces both. Three implications follow. Persistent low agency is not generic: it needs a fit threshold and an intermediate legibility window. Raising legibility within the window does not by itself dislodge people already in the low state, because that state is stable; it benefits mainly those near or above the threshold. And a one-off pulse of assistance that lifts a person's capability above e_c, or a one-off shock that pushes it below, can have persistent effects when L lies in the window. These are properties of the stylised map. They would be contradicted by evidence that outcomes after a failed encounter do not depend on the encounter once heterogeneity is controlled, or that the dependence does not vary with legibility.

Two limits should be stated. The mean-map fixed points describe the conditional mean of a stochastic process, and a population with heterogeneous capability and fit will not sit at a single $e*$. And the user dynamics and the institutional dynamics are coupled: a higher π lowers A, which lowers e, which lowers $\mathbb{P}$, which raises $\pi*$. This loop is likely to amplify low states, but its joint analysis is not attempted here and no claim of multiplicity is made on its basis. Given the contested empirical record on poverty traps (Kraay and McKenzie 2014), the bistability result is a derived hypothesis, not a finding.

5 Propositions and boundary conditions

Six propositions follow from Results 1 to 5. Each states the construct, the outcome, the mechanism, boundary conditions, the observable implication, the closest alternative explanation and the evidence that would count for or against it. P1, P2 and P6 distinguish the theory from the closest existing accounts (Table 1); P4 and P5 carry its dynamic implications.

Proposition 1

(stage localisation). An intervention that raises downward legibility L changes the share of users who correctly identify status and next step, but does not change the rate at which valid, filed, evidence-complete challenges are upheld; an intervention that raises corrective accountability Q changes the latter and not the former.

Mechanism. Equations (1) to (3): L enters only the interpretation stage and Q only the review stage.

Boundaries. Clearer messages may also improve the quality of evidence users submit, which changes case merits; comparisons must be merit-adjusted. The proposition presumes the review unit is separate from the message designer.

Observable. In a design that randomises message redesign and independent re-review, effects on interpretation and task-completion rates load on the first, and effects on merit-adjusted upheld rates load on the second.

Alternative. A single-latent burden account predicts effects of any friction-reducing intervention spread across stages; a trust account predicts changes in perceived fairness without changes in correctness.

Evidence. Stage-specific effects of the predicted kind support it; uniform effects across stages, or message effects on merit-adjusted review outcomes, weaken the stage structure.

Proposition 2

(complementarity). The effect of user-side support (training or assistance) on the probability of warranted correction is proportional to $L \cdot U \cdot Q$; it is near zero where any of the three is near zero.

Mechanism. Result 1: P is a product of stage probabilities.

Boundaries. Weakened where assisted channels provide a bypass of stages one and two (A1), and where fit saturates so that further support adds little.

Observable. In a factorial field experiment crossing user support with message redesign, the ratio of support effects across legibility arms approximates the ratio of the arms' legibility levels.

Alternative. A human-capital or digital-literacy account predicts that training helps by a similar amount regardless of institutional design; an additive burden model predicts no proportionality.

Evidence. Proportional or super-additive effects support it; equal effects across arms contradict it.

Proposition 3

(accuracy–legibility condition). A system change that lowers the audited wrongful-decision rate while lowering downward legibility raises the uncorrected-error burden for users whose fit is above a critical level, and lowers it for others.

Mechanism. Result 2, with the critical level given by $\Theta*$.

Boundaries. Applies only where legibility actually falls with the change; it is silent on whether accuracy and legibility must trade off. Fraud-security limits on disclosure bound the feasible *L*.

Observable. After a model upgrade that reduces explanation detail, merit-audited uncorrected wrongful decisions rise among high-fit users (for example, frequent users with assisted-channel access) even though aggregate audited error falls.

Alternative. Compositional change in who is flagged; changes in complaint propensity after publicity.

Evidence. A heterogeneous pattern of this kind in case-level audits supports it; uniform improvement, or uniform deterioration, weakens the specific condition.

Proposition 4

(error persistence and reversal-rate ambiguity). Across institutions with comparable inflows of new errors and learning rates, audited error rates decline with average effective contestation, whereas steady-state reversal rates do not. After a regulatory or design change that raises effective contestation, reversals rise transiently and the recurrence of previously corrected error types falls permanently.

Mechanism. Result 3.

Boundaries. Presumes that corrected cases are the principal source of the institution's knowledge of its own errors; other detection channels (internal audit, supervisory inspection) weaken it.

Observable. Event studies around mandated dispute-channel changes; provider-level comparison of audited error with reversal and contestation measures.

Alternative. Reverse causation (complaint-rich providers are error-rich), changes in awareness, or learning that occurs independently of complaints.

Evidence. A transient reversal rise followed by lower recurrence supports it; a permanent rise in reversals with no change in recurrence weakens it.

Proposition 5

(state dependence conditional on legibility). For users with comparable baseline capability, an adverse encounter that ends without agency lowers the probability of effective agency in later encounters relative to one that ends with agency, and the gap is larger where downward legibility is lower.

Mechanism. Eq. (7) with the fixed points of equations (8) to (10).

Boundaries. Requires a fit threshold for multiplicity; weak where users can switch provider, obtain persistent assistance or rarely repeat the encounter type.

Observable. Within-person panels of repeated encounters, with outcomes after failure compared with outcomes after success, separately by legibility condition.

Alternative. Persistent unobserved heterogeneity and selection into complaining, which mimic state dependence (Heckman 1981).

Evidence. Persistence that survives pre-period controls and quasi-random assignment of cases to handlers of differing stringency, and that varies with legibility, supports it; persistence that vanishes under such controls weakens it.

Proposition 6

(source of group gaps). Gaps in resolution between disadvantaged and other users that arise from capability fit appear at the interpretation and filing stages and shrink with assistance; gaps that arise from credibility deficits appear at the review stage, conditional on filing and on case merits, and do not shrink with assistance.

Mechanism. Fit enters *s* and *c*; a credibility deficit is a violation of A4, with *Q* lower for some claimant groups.

Boundaries. Distinguishing the two requires independent merit assessment; hermeneutical gaps may appear as low *U* for claims that the form cannot represent, and then look like fit problems.

Observable. Stage-wise funnel data by group with blinded merit scoring of a sample of filed cases.

Alternative. A single-source account, either a digital divide or discrimination, predicts gaps at one stage only.

Evidence. Dissociation between stages and responses to assistance supports it; a gap at one stage only, or gaps at review that shrink with assistance, weakens it.

The propositions are jointly informative. If P1 and P2 both fail, the stage structure should be abandoned. If P3 and P4 fail, the asymmetry argument loses its distinctive content and the model reduces to a restatement of conversion factors and burden. P5 is the most speculative and is stated as a derived hypothesis.

6 Application: failed transactions and grievance redress in India’s UPI

6.1 Purpose and status of the exercise

UPI is used here as a structured illustration. It suits the purpose because the path from a failed or disputed transaction to redress is codified in public documents, because responsibility is divided among several regulated entities behind a single interface, and because the scale makes any inattention to the exception costly. It is not used because UPI users generally struggle to understand their transactions.

The sources examined contain no reliable evidence for that claim, and none is asserted. No original data are analysed, and the exercise should be read as theoretical application and as a specification of the evidence needed, not as validation.

6.2 The sequence mapped to the model

The sequence of eight steps runs from a transaction, through a failure or disputed decision, the communication of a status or reason, the user's attempt to interpret it, the search for help or review, the institution's investigation, the disposition, and the effect of the outcome on later behaviour and institutional processes. Table 3 maps these steps to the model's stages and sets the public material against what it can and cannot show.

Table 3

The UPI failure-to-redress sequence: public material and its evidential limits

Steps and model stage	Public material	What it shows	What it cannot show
1. Transaction; scale	NPCI statistics for September 2026 (NPCI 2026a): about 24.07 billion transactions, ₹29.37 lakh crore, as reported on release	Scale of exposure to potential failure	Failure rates, causes or who experiences them
2. Failure or disputed decision; error rate π	RBI (2019): a failed transaction is one not completed for reasons not attributable to the customer; for UPI, auto-reversal by T + 1 where a transfer is not credited and by T + 5 where a merchant payment is not confirmed; ₹100 per day of delay; compensation paid suo moto, without waiting for a complaint	For covered classes the institution must act without a claim, which removes dependence on stages one and two. Attribution is itself an institutional classification	How often covered failures occur; the share of disputes outside covered classes (wrongful holds, merchant disputes, fraud); accuracy of attribution
3. Status communicated; legibility L	NPCI complaint-status page (NPCI 2026b): NPCI makes the complaint available to the member holding the complainant's account, and that member is responsible for resolution; NPCI offers an assistant (UPI Help) for guidance	Responsibility sits with members behind the interface; interface wording is provider-specific	What status messages users actually see; whether they name the responsible entity and the next step
4. User interprets; fit m_1	None found in public institutional sources	—	Comprehension of status and next step. The public institutional sources used here do not report these measures.
5. Help or review sought; uptake U, fit m2	RB-IOS 2026: a prior complaint to the regulated entity is generally required before Ombudsman escalation, subject to the Scheme's maintainability rules.	A multi-step redress path exists; formal availability of a channel does not establish that users can navigate it.	Share of failed or disputed UPI transactions that become complaints; reasons for not filing; capability and assistance differences.

Note: Ombudsman figures are taken from press summaries of the report and were not checked against the original report; they are used only to illustrate the shape of the pathway.

Steps and model stage	Public material	What it shows	What it cannot show
6 to 7. Investigation and disposition; accountability Q	RB-IOS 2026 specifies maintainability, rejection and appeal rules for complaints handled under the Scheme.	The institutional route and formal grounds for disposition can be mapped.	Whether particular rejections or settlements were correct, the share of disputes never filed, and the effect of review on later error recurrence.
8. Later behaviour and processes; λ, μ, γ	No public series linking complaints to process fixes or to later user behaviour found	—	Whether corrected cases lead to fixes; whether users learn or withdraw
Note: Ombudsman figures are taken from press summaries of the report and were not checked against the original report; they are used only to illustrate the shape of the pathway.			

6.3 Interoperability is not legibility

Technical interoperability standardises messages between institutions so that a payment initiated in one application can settle between accounts at different banks. It does not, by itself, tell the person which institution holds responsibility, what a status means or what to do next. The public record shows that NPCI routes complaints to members, who resolve them, and that a person may need to approach the application provider, the bank and then the Ombudsman in sequence. On the model, this structure creates conditions in which U and Q may vary across members and across the points at which a complaint enters, and in which the learning demand d_1 includes the task of discovering who is responsible. Whether they do vary is an empirical question that public statistics cannot answer.

6.4 What the case shows, and what it does not

The case shows four things. The path from failure to redress is codified and multi-party. The 2019 framework removes dependence on user capability for covered failures by requiring suo moto compensation, which is an instance of designing away the first two stages for a well-defined class; the theory's relevance therefore concentrates on cases that fall outside covered classes or in which attribution or merits are contested. Public statistics on volumes, complaint counts and disposal splits cannot identify L, U, Q, P or π. And the rejection and settlement splits are ambiguous in exactly the way Result 3 predicts: a high rejection share is compatible with accurate institutions and with institutions that dismiss valid claims, and a stable reversal share is compatible with very different error rates.

The case does not show that UPI users generally cannot understand their transactions, that any member fails on legibility, uptake or review, or that any proposition holds. Two pieces of causal evidence from related Indian settings bound the inference. A large field experiment on identity verification in public food distribution found that the effects of stricter authentication depended on how the transition and its exceptions were managed (Muralidharan et al. 2025), which is consistent with the premise that protocol design shapes who is excluded, though the setting is state welfare delivery, not UPI. And an earlier

experiment on biometric smartcards found improved delivery (Muralidharan et al. 2016), a reminder that digital arrangements can raise effective outcomes and that the argument concerns design of the exception path, not digital delivery as such.

6.5 Evidence needed to test the propositions

Table 4 sets out designs for each proposition. Most require case-level data held by regulators and providers, stage-wise funnel measures, and merit assessment by reviewers blind to the original disposition. Audit designs that submit synthetic claims to live grievance systems raise ethical and legal issues and would need regulatory sanction and ethical review; vignette and supervised-data designs are alternatives.

Table 4
Proposed tests

Prop.	Data and measures	Design	Principal identification threat
P1	Stage rates: status interpreted, challenge filed and captured, merit-adjusted upheld	Cross-randomised message redesign and independent re-review	Messages change evidence quality; spillovers across arms
P2	Warranted-correction rate by arm	Factorial trial of assistance or training by message design	Helper bypass of stages; ceiling effects
P3	Case-level audited wrongful decisions and uncorrected burden by user fit	Before-and-after comparison around a model change, by fit group, with blind merit rating	Change in who is flagged; publicity effects on complaining
P4	Provider panel: audited error, reversal counts, contestation measures, recurrence of error types	Event study around mandated dispute-channel changes	Reverse causation; changing awareness
P5	Repeated encounters per user with baseline capability measures	Panel with quasi-random assignment of cases to handlers of differing stringency	Persistent heterogeneity; selective complaining
P6	Funnel by group with blinded merit scoring of filed cases	Group comparison by stage, with and without assistance; vignette experiments	Unobserved merit differences; ethics of audits

Note: Designs are proposals; none has been implemented.

7 Contributions and implications

7.1 Contribution to theory

The article makes three contributions. First, it places conversion factors, administrative burdens, credibility deficits and contestability duties inside one stage-structured encounter model, in which each

becomes a parameter or a restriction: conversion factors and burdens enter through fit and the learning and compliance demands; hermeneutical injustice appears as low uptake for claims the form cannot represent; testimonial injustice appears as a violation of review neutrality. This does not replace the accounts. It makes explicit what each predicts at which stage. Second, it derives results that the accounts do not state: the product structure and the proportionality of support effects to institutional parameters, the accuracy–legibility condition, the invariance of steady-state reversal rates, and the legibility window in which low and high capability states coexist. Third, it generates six propositions that can fail, each paired with an alternative explanation and a design (Table 4).

The contribution is bounded. The model is stylised and the application is illustrative. It sits alongside, rather than above, existing work on automated administrative systems, which documents harms to poor and marginalised people (Eubanks 2018; Pasquale 2015). Its proposed added value is to specify where within an encounter such harms may arise and what observations would be needed to test that account. For readers of this journal, whose published work includes survey-based modelling of financial-inclusion effectiveness (Kumar and Hasan 2026) and cross-country analysis linking inclusion to growth, stability and profitability (Pal and Bandyopadhyay 2022), the article addresses a complementary layer: what happens at the moment inclusion is tested by a failure.

7.2 Implications for financial institutions and managers

Institutions should measure warranted correction and effective agency, not case closure. This requires a stage-wise funnel (the share of adverse outcomes with an actionable status and reason, the share of challenges captured with their context, the share reviewed independently) together with a merit-audited sample that estimates the wrongful-decision rate and the correction rate. Satisfaction and perceived justice from complaint-handling research remain useful but should be reported separately, since they can diverge from correctness. Reversal rates should not be used alone as quality indicators, and a rise in reversals after a new dispute channel should be read first as possible learning. Model upgrades should be treated as changes to legibility as well as to accuracy, and paired with a contestation audit for users who are best placed to catch errors. Assisted channels should be understood as both a bypass of the early stages and an investment in fit.

7.3 Implications for regulators and development policy

Automatic remedy for well-defined classes of failure, as in the 2019 framework, is the strongest design response because it removes dependence on user capability. For classes whose attribution or merits are contested, the model points to three levers: standardised status and reason codes that name the responsible entity and next step (legibility), single-window capture of a challenge with its context and visible allocation of responsibility among entities (uptake), and independent review with published, merit-audited outcomes (accountability). Reporting requirements could include the stage-wise funnel and a merit-audited sample. Legibility must be balanced against fraud security, and the model suggests compensating for a lower feasible L through uptake and review. For development finance more broadly,

indicators of account ownership and usage leave unmeasured the stage at which inclusion is tested, and recourse indicators should accompany them.

8 Limitations and research agenda

The model is deliberately small. It treats one decision class at a time, assumes stage necessity and conditional independence, uses probabilities in place of strategic behaviour by institutions, users or fraudsters, and analyses the conditional mean of user dynamics rather than a heterogeneous population. The bistable window depends on a threshold fit function; with smooth concave fit and the stated parameter conditions the model is monostable. The coupled dynamics of user capability and institutional error rates are not solved. A richer treatment would allow bypass paths, heterogeneous users, strategic complaint behaviour and endogenous legibility under a security constraint.

The application rests on public documents and press summaries of an annual report whose original text was not accessed, and the public record does not contain the stage-wise data the propositions require. The literature and journal-fit checks were partial: Springer's journal pages could not be retrieved by automated means, and the search of this journal's archive was limited, so the novelty claim is restricted to the sources examined. The research agenda follows from the propositions: obtain stage-wise data through regulators, run cross-randomised field experiments on message design, assistance and review, estimate state dependence in repeated encounters against heterogeneity, and test the accuracy–legibility condition around real model changes. Comparative applications to credit scoring and welfare authentication would test whether the mechanism travels beyond payments.

9 Conclusion

Formal access to a digital financial system does not guarantee recourse when a decision is adverse or disputed. This article argues that access becomes effective agency through a sequence of conversions between institution and person, shaped by the relative capacities to classify, interpret, contest and correct. Under stated assumptions, the model derives a product structure for warranted correction, a condition under which improved decision accuracy combined with reduced legibility can increase uncorrected errors, a steady-state ambiguity in reversal rates, and a possible bistable interval when capability fit has a threshold. Six propositions make these implications testable. India's UPI illustrates where the stages may sit within a real grievance system; it does not validate the model. The contribution is to make the mechanism and its empirical tests explicit.

Declarations

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Competing interests- One of the authors is employed by the Reserve Bank of India, which regulates the payment systems discussed in this article. The article was written in a personal academic capacity, uses

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Data availability. No datasets were generated or analysed. The institutional material cited is publicly available; sources are identified in the text and reference list. The numerical illustrations in Section 4 follow from the stated equations and parameter values.

Ethics approval and consent to participate. Not applicable: the article involves no human participants, personal data or animal subjects.

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References

1. Almada M (2019) Human intervention in automated decision-making: Toward the construction of contestable systems. In: Proceedings of the 17th International Conference on Artificial Intelligence and Law. ACM, New York, pp 2–11
2. Ananny M, Crawford K (2018) Seeing without knowing: Limitations of the transparency ideal and its application to algorithmic accountability. New Media Soc 20(3):973–989. https://doi.org/10.1177/1461444816676645
3. Azariadis C, Stachurski J (2005) Poverty traps. In: Aghion P, Durlauf SN (eds) Handbook of economic growth, vol 1A. Elsevier, Amsterdam, pp 295–384. https://doi.org/10.1016/S1574-0684(05)01005-1
4. Bandura A (1977) Self-efficacy: Toward a unifying theory of behavioral change. Psychol Rev 84(2):191–215. https://doi.org/10.1037/0033-295X.84.2.191
5. Barrett CB, Carter MR (2013) The economics of poverty traps and persistent poverty: Empirical and policy implications. J Dev Stud 49(7):976–990. https://doi.org/10.1080/00220388.2013.785527
6. Bovens M (2007) Analysing and assessing accountability: A conceptual framework. Eur Law J 13(4):447–468. https://doi.org/10.1111/j.1468-0386.2007.00378.x
7. Byskov MF, Kramm M, Östlund S (2024) Capabilities as substantive opportunities and the robustness of conversion factors. In: Sardoč M (ed) Handbook of equality of opportunity. Springer, Cham. https://doi.org/10.1007/978-3-031-55897-9_14
8. Dalton PS, Ghosal S, Mani A (2016) Poverty and aspirations failure. Econ J 126(590):165–188. https://doi.org/10.1111/ecoj.12210

9. Dannefer D (2003) Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory. J Gerontol B Psychol Sci Soc Sci 58(6):S327–S337. https://doi.org/10.1093/geronb/58.6.S327
10. Döring M (2021) How-to bureaucracy: A concept of citizens' administrative literacy. Adm Soc 53(8):1155–1177. https://doi.org/10.1177/0095399721995460
11. Dotson K (2011) Tracking epistemic violence, tracking practices of silencing. Hypatia 26(2):236–257. https://doi.org/10.1111/j.1527-2001.2011.01177.x
12. Eubanks V (2018) Automating inequality: How high-tech tools profile, police, and punish the poor. St. Martin's, New York
13. Fricker M (2007) Epistemic injustice: Power and the ethics of knowing. Oxford University Press, Oxford
14. Gelbrich K, Roschk H (2011) A meta-analysis of organizational complaint handling and customer responses. J Serv Res 14(1):24–43. https://doi.org/10.1177/1094670510387914
15. Giest S, Samuels A (2023) Administrative burden in digital public service delivery: the social infrastructure of library programs for e-inclusion. Rev Policy Res 40(5):626–645. https://doi.org/10.1111/ropr.12516
16. Hegemann M, Ritz A (2026) Administrative burden in digital service provision: A systematic literature review and research agenda. Perspect Public Manag Gov. https://doi.org/10.1093/ppmgov/gvag004., gvag004
17. Heckman JJ (1981) Heterogeneity and state dependence. In: Rosen S (ed) Studies in labor markets. University of Chicago Press, Chicago, pp 91–140
18. Herd P, Moynihan DP (2018) Administrative burden: Policymaking by other means. Russell Sage Foundation, New York. https://doi.org/10.7758/9781610448789
19. Hirschman AO (1970) Exit, voice, and loyalty: Responses to decline in firms, organizations, and states. Harvard University Press, Cambridge, MA
20. Kaminski ME, Urban JM (2021) The right to contest AI. Columbia Law Rev 121(7):1957–2048
21. Karimi A-H, Barthe G, Schölkopf B, Valera I (2022) A survey of algorithmic recourse: Contrastive explanations and consequential recommendations. ACM Comput Surv 55(5):95. https://doi.org/10.1145/3527848
22. Kleine D (2013) Technologies of choice? ICTs, development, and the capabilities approach. MIT Press, Cambridge, MA
23. Kraay A, McKenzie D (2014) Do poverty traps exist? Assessing the evidence. J Econ Perspect 28(3):127–148. https://doi.org/10.1257/jep.28.3.127
24. Kroll JA, Huey J, Barocas S, Felten EW, Reidenberg JR, Robinson DG, Yu H (2017) Accountable algorithms. Univ Pa Law Rev 165(3):633–705
25. Kumar SS, Hasan F (2026) Exploring the constructs of the effectiveness of financial inclusion: a confirmatory structural equation modelling (SEM) approach. SN Bus Econ 6:78.

https://doi.org/10.1007/s43546-026-01090-z

26. Lyons H, Velloso E, Miller T (2021) Conceptualising contestability: Perspectives on contesting algorithmic decisions. Proc ACM Hum-Comput Interact 5(CSCW1):106. https://doi.org/10.1145/3449180
27. Madsen CØ, Lindgren I, Melin U (2022a) The accidental caseworker: how digital self-service influences citizens' administrative burden. Gov Inf Q 39(1):101653. https://doi.org/10.1016/j.giq.2021.101653
28. Madsen JK, Mikkelsen KS, Moynihan DP (2022b) Burdens, sludge, ordeals, red tape, oh my! A user's guide to the study of frictions. Public Adm 100(2):375–393. https://doi.org/10.1111/padm.12717
29. Medina J (2013) The epistemology of resistance: Gender and racial oppression, epistemic injustice, and resistant imaginations. Oxford University Press, Oxford
30. Moynihan D, Herd P, Harvey H (2015) Administrative burden: Learning, psychological, and compliance costs in citizen–state interactions. J Public Adm Res Theory 25(1):43–69. https://doi.org/10.1093/jopart/muu009
31. Muralidharan K, Niehaus P, Sukhtankar S (2016) Building state capacity: Evidence from biometric smartcards in India. Am Econ Rev 106(10):2895–2929. https://doi.org/10.1257/aer.20141346
32. Muralidharan K, Niehaus P, Sukhtankar S (2025) Identity verification standards in welfare programs: Experimental evidence from India. Rev Econ Stat 107(2):372–392. https://doi.org/10.1162/rest_a_01296
33. Myrdal G (1957) Economic theory and under-developed regions. Duckworth, London
34. National Payments Corporation of India (2026a) UPI product statistics. https://www.npci.org.in/product/upi/product-statistics. Accessed 29 October 2026. Figures for September 2026 as reported on release
35. National Payments Corporation of India (2026b) User complaint status. https://www.npci.org.in/complaint-status. Accessed 29 October 2026
36. Nichols AL, Zeckhauser RJ (1982) Targeting transfers through restrictions on recipients. Am Econ Rev 72(2):372–377. https://doi.org/10.1257/aer.72.2.372
37. Pal S, Bandyopadhyay I (2022) Impact of financial inclusion on economic growth, financial development, financial efficiency, financial stability, and profitability: An international evidence. https://doi.org/10.1007/s43546-022-00313-3. SN Bus Econ
38. Pasquale F (2015) The black box society: The secret algorithms that control money and information. Harvard University Press, Cambridge, MA
39. Pohlhaus G (2012) Relational knowing and epistemic injustice: toward a theory of willful hermeneutical ignorance. Hypatia 27(4):715–735. https://doi.org/10.1111/j.1527-2001.2011.01222.x
40. Reserve Bank of India (2019) Harmonisation of turn around time (TAT) and customer compensation for failed transactions using authorised payment systems. RBI/2019-20/67, DPSS.CO.PD No.

629/02.01.014/2019-20, 20 September 2019. https://rbi.org.in/commonman/English/Scripts/Notification.aspx?Id=3074. Accessed 29 October 2026

41. Reserve Bank of India (2026) Reserve Bank – Integrated Ombudsman Scheme, 2026: frequently asked questions. https://www.rbi.org.in/commonperson/english/scripts/FAQs.aspx?Id=3407. Accessed 29 October 2026
42. Robeyns I (2005) The capability approach: A theoretical survey. J Hum Dev 6(1):93–117. https://doi.org/10.1080/146498805200034266
43. Robeyns I (2017) Wellbeing, freedom and social justice: The capability approach re-examined. Open Book, Cambridge. https://doi.org/10.11647/OBP.0130
44. Rudin C (2019) Stop explaining black box machine learning models for high stakes decisions and use interpretable models instead. Nat Mach Intell 1(5):206–215. https://doi.org/10.1038/s42256-019-0048-x
45. Sen A (1985) Commodities and capabilities. North-Holland, Amsterdam
46. Sen A (1999) Development as freedom. Oxford University Press, Oxford
47. Smith AK, Bolton RN, Wagner J (1999) A model of customer satisfaction with service encounters involving failure and recovery. J Mark Res 36(3):356–372. https://doi.org/10.1177/002224379903600305
48. Tax SS, Brown SW, Chandrashekaran M (1998) Customer evaluations of service complaint experiences: Implications for relationship marketing. J Mark 62(2):60–76. https://doi.org/10.2307/1252161
49. Wachter S, Mittelstadt B, Russell C (2018) Counterfactual explanations without opening the black box: Automated decisions and the GDPR. Harv J Law Technol 31(2):841–887
50. Zheng Y, Walsham G (2008) Inequality of what? Social exclusion in the e-society as capability deprivation. Inf Technol People 21(3):222–243

Figures

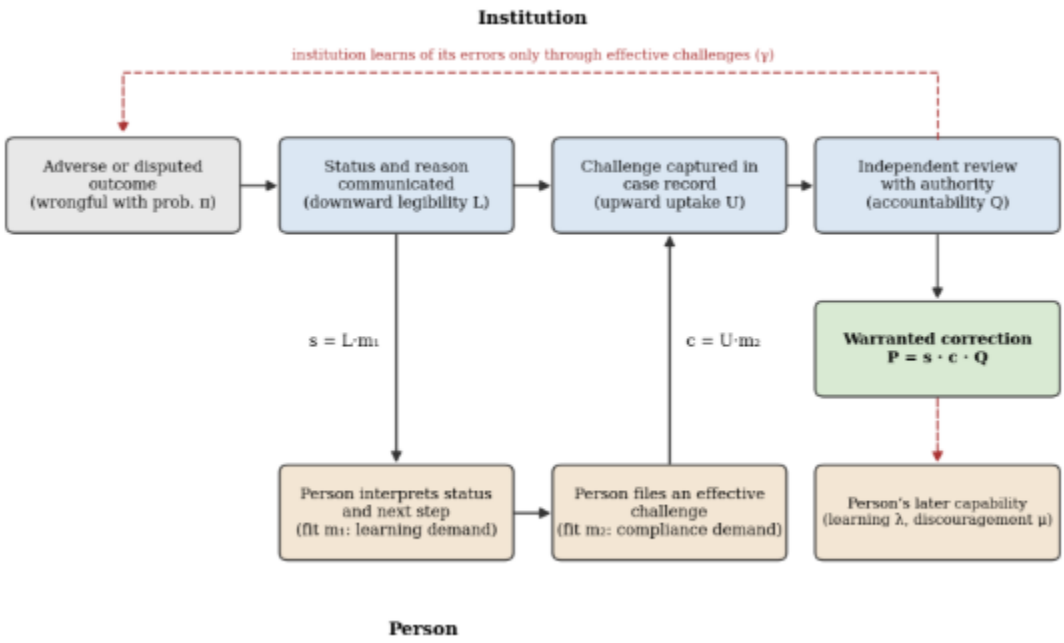


Figure 1

The encounter as a two-sided conversion chain. Solid arrows are stages (downward legibility *L*, upward uptake *U*, corrective accountability *Q*, and the person's fit with learning and compliance demands). Dashed arrows are the two feedback loops analysed in Sections 4.3 and 4.4.

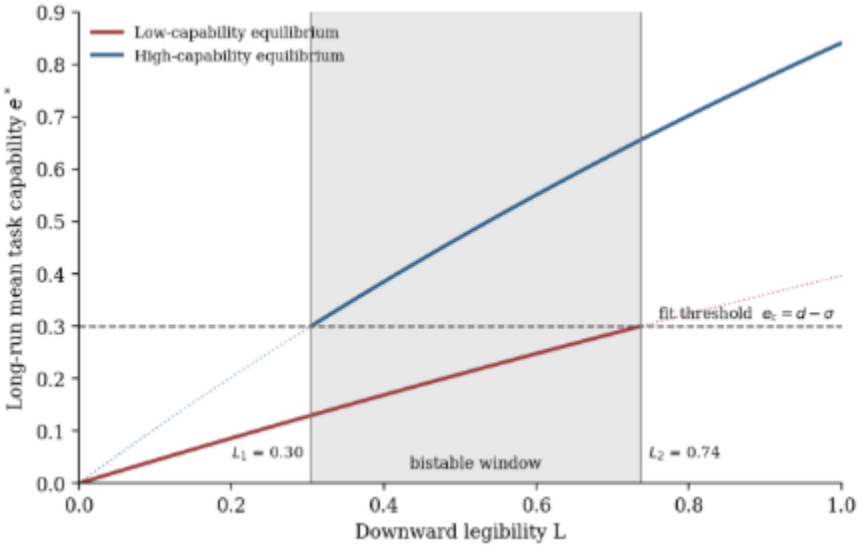


Figure 2

Long-run capability equilibria as downward legibility varies, under a threshold fit function. Parameter values are illustrative and computed from equations (8) to (10), not estimated: $\lambda = 0.40$, $\mu = 0.30$, $\delta = 0.05$, $\pi = 0.05$, $U = Q = 0.8$, $d = 0.30$, $\sigma = 0$, $m_{lo} = 0.40$, $m_{hi} = 0.95$, giving $A* = 0.284$, $L_1 = 0.30$ and $L_2 = 0.74$. Dotted segments are inadmissible fixed points.