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IMPACT OF UPI AND DIGITALIZATION ON CASH-BASED INFORMAL MICRO-MARKETS IN INDIA: FINANCIAL INCLUSION OR DIGITAL FRAGMENTATION

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ABSTRACT

You are a digital finance enthusiast, often called an expert working for India's Unified Payments Interface (UPI). The system is a champion of digital financial inclusion, but the broader economic story is easier to tell than the sociological nuances on the ground. This paper attempts to explore notions of inclusion and exclusion in India and the ways in which the rapid digitalization of cash-based informal markets like street vendors and mobile hawkers, who constitute about 93 percent of the workforce, is transforming. The research uses a mixed-method research approach and is based on qualitative data from five interviews and a localized survey of informal vendors in Lucknow. It discusses digital integration from the perspective of the network society framework as proposed by Manuel Castells and the idea of moral economy. UPI has a different challenge: it promotes inclusion and also leads to fragmentation during the process of digitalization. It offers new opportunities for transactions but also a threat to existing systems of trust, social solidarity and local credit. Moreover, structural inequalities such as age, education, caste and gender are key determinants of access to and security within this digital infrastructure. The findings indicate that adoption exists, but it is often superficial. More than two in five vendors still use cash. Daily use is concentrated among younger, male and better educated vendors, while digital precarity increases sharply with age and lower educational levels. The platform is mainly used on a daily basis by younger, male, and better-educated vendors, and the digital precarity of older and less-educated vendors is rapidly increasing. hese dynamics culminate in what we refer to as "layered digital precarity," designating a condition of apparent digital

connectedness, beneath which lies severe functional insecurity. In closing, these findings are valuable for identifying relevant approaches to designing fintech policy, building social protection frameworks, and understanding the broader digital/economic sociology of life in the Global South.

Keywords: *UPI[1]; Financial inclusion[2]; Informal economy[3]; Moral economy[4]; Network society[5]; Digital divide[6]; Digital fragmentation[7]*

1. INTRODUCTION

1.1 The Promise of UPI: Digital Inclusion at Scale

There are only a handful of financial technologies that have scaled this quickly. One such example is India's Unified Payments Interface (UPI). The instant payment system that enables device interoperability was developed by the National Payments Corporation of India (NPCI) and was launched in April 2016. The system grew from about two million transactions in its first year to over 24 billion transactions by FY2025-26 (NPCI, 2026), an almost 12,000 times increase, with around 314 lakh crores in transaction value[1]. UPI-related payments will account for about half of global real-time payments by 2025 and over four-fifths of India's retail digital payment volume and person-to-merchant transactions, the segment that interacts with small retailers, were more than three-fifths (63 per cent) of total volume between 2016 and 2025 (NPCI, 2026). This pattern is reflected in every payment system indicator and echoes across the Reserve Bank of India's annual reviews (RBI, 2024)[2]. This trend has been observed in all payment system indicators in the Reserve Bank of India's annual reviews (RBI, 2024). Policy discourse has shown such infrastructure as an inherently democratizing force, from the committee on financial inclusion (Rangarajan, 2008) to the very architecture of the India Stack (D'Silva et al., 2019): via zero merchant discount rates, interoperable QR codes, and vernacular interfaces, it is positioned that they will draw those outside the formal MSME system into its orbit[3]. However, the aggregate statistics are simply that aggregate data. They do not report traders; they report transactions, not livelihoods, but volumes. The macro-picture hides the granular sociology of how UPI is actually experienced by the small, cash-based operators, who sit at the final mile of India's retail economy (Pal et al., 2018)[4]. This paper takes as its starting point the proposition that financial inclusion is more an issue to be interrogated at the level of point of contact than a bench-marking volume number to be heralded at the level of the nation[5].

1.2 The Blind Spot: Informal Micro-Markets

The informal economy in India is not a residual category; it is the economy of most Indians. According to the National Sample data, nine out of ten workers are informal workers (National Sample Survey Office [NSSO], 2014; International Labor Organization [ILO], 2018) and ten million people across urban India are engaged in street vending mainly (Bhowmik, 2005; Ministry of Housing and Urban Poverty Alleviation, 2009)[6]. Street vendors, mobile hawkers, and petty traders operate in what Chen (2007, 2012) calls the informal economy: unregistered, unregulated businesses, facilitated by the cash nexus, kinship and neighborhood credit, but not bank intermediation[7]. These micro-markets are sociologically distinct as trust is personal and exchange occurs within the framework of relationships (Polanyi, 1944; Thompson, 1971; Scott, 1976). Credit is given and taken in networks of suppliers, co-vendors, and shopkeepers without written contracts or official rates of interest (Mauss

1954; Graeber 2011)[8]. The deployment of UPI is not just a neutral upgrade of payment infrastructure or the introduction of new technology, it reconfigures the structure of trust, obligation and reciprocity that sustains the informal economy[9]. Statistical reviews of street vending point to a relatively uniform set of conclusions across cities (cf. Bromley, 2000), and Indian ethnographies have described hawkers maneuvering the local urban milieu in powers that be as everyday accommodation (Anjaria, 2006) or entangled with new regimes of consumption and surveillance at large (Rajagopal, 2001)[10]. However, little attention has been given by both policy and scholarship to the ground-level impact of these micro-markets relative to their propensity for volume statistics (Bhowmik, 2010). The current research conceptualizes informal micro-markets as active contexts in which inclusion and fragmentation occur together rather than as passive victims of digitalization[11].

1.3 Research Questions and Organization of the Paper

The paper answers four research questions. Research Questions: First, what type of UPI adoption and usage patterns are observed among cash-based informal vendors in a tier-2 Indian city? Secondly, in what ways does digitalization transform the trust relations and informal credit arrangements that underpin the moral economy of such markets? Third, how do age, gender, education, and social category mediate the process of adoption and functional digital security? Fourth, and most importantly: Is UPI making for financial inclusion, digital fragmentation, or both at the same time? A structured survey of 40 informal vendors in Lucknow, Uttar Pradesh, and 5 semi-structured interviews are conducted to answer these questions, which entails the study design. The structure of the paper is as follows[12]. Section 2 reviews the literature on digital finance and the informal economy, highlighting the digital divides. Identifying the role of digital finance within the informal economy This section identifies the role of digital finance within the informal economy and highlights the resulting digital divides.[13] Distilling research gaps Section 3 explains the methodology. Section 4 describes the data collection and analysis, framed by five tabular datasets presenting the demographic profile, digital adoption, transaction behavior, trust and moral economy, and digital precarity of the sample. Section 5 provides a comparative discussion of the findings and related prior work, while Section 6 concludes with discussions of policy implications and the concept of "layered digital precarity." 'From the paradox of inclusion and fragmentation in the abstract, through tables and charts, to a conclusion urged for functionally meaningful inclusion, there is a chain of evidence that is deliberate[14].

2. SURVEY OF LITERATURE

2.1 Digital Finance and the Inclusion Paradigm

The digital-finance literature has a plethora of studies, but two strands dominate. The first is the well-known mobile-money success story of M-Pesa in Kenya, reported with data by Jack and Suri (2014)[15], showing that mobile money reduced transaction costs and improved risk sharing, while Suri and Jack (2016)[16] estimated that it helped about two percent of Kenyan households escape extreme poverty, especially female-headed ones. Previous mobile phone and development work, especially in Africa, has demonstrated that connectivity lowers search and coordination costs for poor producers and traders (Aker & Mbiti, 2010)[17]. The second component is the Indian context. Chodorow-Reich, Gopinath, Mishra, and Narayanan (2020) showed that the 2016 demonetization led to a permanent change in payment patterns and real output losses[18]. Agarwal, Ghosh, Li,

and Ruan (2024) showed that consumers with more cash dependence before the shock increased digital payment penetration and expenditure after the shock. d) Infrastructure Design Level D'Silva et al. (2019) have suggested the unique architecture, interoperability and zero cost to consumers with its extraordinary adoption of UPI[19]. But most of this literature deals with volumes, consumption, and macro-ratios; the transaction is its unit of analysis, not the trader[20]. Pal et al. provide insights for the locations where evidence at the street level is available. In the wake of demonetization, Kaur's (2018) ethnography of Indian street shops reveals shopkeepers grappling with devastating transactions with frozen balances and intermediaries, a finding that challenges the narrative of aggregate inclusion[21].

2.2 The Informal Economy and the Moral Economy

The second lens comes from the sociological literature on informality. Hart (1973) was the first to theorize about informal income opportunities in urban Ghana. De Soto (1989) argued persuasively that informality is a product of regulatory exclusion, and Portes, Castells, and Benton (1989) placed informal economies within the context of capitalism's restructuring[22]. Bhowmik (2005, 2010) found that street vending is widespread and heterogeneous in India and its legal position is tenuous, while Anjaria (2006, 2011) illustrated how vendors claim urban space against the city agencies by negotiating everyday accommodations[23]. In parallel, the moral economy tradition (Polanyi 1944; Thompson 1971; Scott 1976), in insisting that exchange among subsistence communities is embedded in non-market norms of reciprocity, fairness, and mutual obligation, also cannot address their concerns, which are about lack of market calculation[24]. In Gupta (2012), this sensibility extends from the Indian state to demonstrate how bureaucratic arbitrariness shapes the lives of the poor. from the Indian state itself to indicate how bureaucratic arbitrariness structures the lives of the poor. Moral economy, as explored here, therefore specifically directs attention to how digitalization works through and with the informal architectures of trust and credit that underpin how vendors hedge risk to secure access to working capital[25]. In short, linking all transactions via UPI to non-personalized relationships may lead to the gradual decline of the very institutions that sustain these markets without banks[26].

2.3 Digital Divides in the Network Society

A network society, as theorized by Castells (1996), includes the idea that being inserted into an informational network grants access to power and wealth, while exclusion would relegate one to a 'fourth world' of disconnection[27]. The insight is operationalized in the literature on the digital divide at an individual level: first-level divides in access (van Dijk, 2005); second-level divides in skills and usage (Hargittai, 2002; DiMaggio &Hargittai, 2001); and third-level divides in measurable outcomes (Ragnedda, 2017; Scheerder, van Deursen, & van Dijk, 2017; Robinson et al., 2015). Helsper (2012), finally, relates digital exclusion to parallel spheres of social exclusion, while Zillien and Hargittai (2009) demonstrate that users also manifest status-based differences[28]. Such frameworks clearly predict the condition we study here: Vendors may appear to be formally connected, but they differ significantly in terms of skill, flexibility, and outcome[29]. Cheap smartphones and data tariffs have reduced the first-level access divide in India, which is specifically why skills, flexibility, and outcomes now determine inequality at second and third levels (van Dijk, 2005)[30].

2.4 Research Gaps

This review highlights three problems that support the current study. Firstly, the macro-quantitative work on UPI generally is broken down to the informal micro-market level that has long been cultural and economically tied into cash generation[31]. Second, the financial inclusion literature analyzes adoption and not the loss or change of informal credit institutions and trust[32]. Third, while acknowledging the existence of skills and outcomes (where third-level divides occur), digital divide analysis has not thoroughly connected these issues with the moral economy of small traders. The fourth practical gap relates to measurement: even among policy datasets, indicators of active use and security are rarely included, which leaves the debate lacking many of the necessary metrics to compare these alternative outcomes[33]. The literature reviewed and the related gaps are presented in Tables 1 and 2. Figure 1 puts UPI growth in standard terms, and Figure 2 shows a preview of the adoption trail observed across sampled vendors.

Table 1: Selected studies on digital finance, the informal economy, and digital divides

Author(s)	Focus	Key finding
Jack & Suri (2014)	Mobile money, risk sharing (Kenya)	Mobile money lowers transaction costs and improves consumption smoothing.
Suri & Jack (2016)	Poverty and gender impacts of M-Pesa	M-Pesa lifted ~2% of Kenyan households out of extreme poverty; female-headed households gained most.
Chodorow-Reich et al. (2020)	Demonetization and cash in India	Demonetization produced a persistent payment shift and real output costs.
Agarwal et al., 2024	Digital payments & consumption (India)	Cash-constrained consumers increased digital usage and spend post-shock.
Pal et al. (2018)	Street shops and the cashless push	Street retailers faced failed transactions, frozen balances and intermediary dependence.
Bhowmik (2005)	Street vendors in Asia	Street vending is large, diverse and legally precarious across Asian cities.
van Dijk (2005)	Digital divide theory	Access, skills and usage divides compound each other across the population.
Williams and Gurtoo, 2012).	Bangalore Street Entrepreneurship	Vendors are driven by mixed motivations and informal entrepreneurship is shaped by structural factors.

Table 1 summarizes the empirical and theoretical background of the study. Rows 1 and 2 the global gold standard of mobile-money success, respectively: Jack and Suri (2014) found M-Pesa reduced transaction costs and improved risk sharing, while Suri and Jack (2016) estimated it lifted approximately two percent of Kenyan households out of extreme poverty, with benefits particularly accruing to female-headed households. Rows 3 and 4 Indian experience of forced digitalization. We find that India's demonetization increases digital payments and spending by cash dependent customers (Chodorow-Reich et al., 2020; Buera et al., 2016, 2024). Row five is the

counterpoint at street level: Pal et al. Such aggregate data does not pick up failed transactions, damage from frozen balances, or the reliance on intermediaries all frictions that private small shopkeepers faced after demonetization, as shown by (2018), for example. Street vending, row six (Bhowmik, 2005), highlights it as a sizable, heterogeneous, and legally contested sector. The digital-divide perspective and informal-entrepreneurship view are provided in rows seven and eight, respectively (van Dijk, 2005; Williams &Gurtoo, 2012). Common to the eight rows is a clear gap between well-defined macro-quantification of digital payments and patchy evidence on micro-sociology of adoption, trust, and credit in informal markets precisely the gap that this paper seeks to address with a primary vendor survey.

Table 2: Research gaps identified from the literature and how this study addresses them

Gap	Description	Addressed by this study
Micro-market scale	UPI research aggregates transactions; few studies disaggregate to street vendors	Survey of 40 informal vendors in a tier-2 city
Use versus registration	Most metrics count accounts, not autonomy or security of use	Purpose-built digital precarity index (0–100)
Moral economy	Financial inclusion work ignores informal trust and credit	Trust scales and informal-credit indicators
Stratification	Digital divide work rarely ties divides to informal labor	Cross-tabulation by age, gender, education and social category
Binary framing	Literature frames inclusion and exclusion as opposites	'Layered digital precarity' concept (inclusion and fragmentation)

The five research gaps resulting from this review are formalized in Table 2, alongside the mapping to each of those gaps and the design choices made in this study. The first of these is scale: UPI research relies on national transaction statistics, which creates analytical blind spots regarding informal micro-markets where cash is culturally embedded; this study addresses those gaps by conducting primary data collection across forty vendors in these informal micro-markets. The second issue is the conflation of registration and use: standard metrics of adoption measure accounts but do not assess independent functioning or the security of that functioning; in response, a designed digital precarity index siphons nominal connectivity from functional security. The third is the under-instrumentation of the moral economy: scholarship on financial inclusion rarely addresses how digital payments might push aside informal trust and credit logics, which generates this survey component with variables revealing each. The fourth issue is stratification: the theory predicts that divides will compound across age, gender, education, and social category, but fewer studies have validated the findings related to informal labor; therefore, the resulting analysis cross-tabulates adoption and precarity across all four attributes. The fifth gap is the binary framing of inclusion versus exclusion, which this study reinterprets as a more complex, layered perspective on digital precarity, where inclusion and fragmentation can occur simultaneously. The gaps together warrant a small, in-depth mixed-methods design rather than yet another macro-level estimation.

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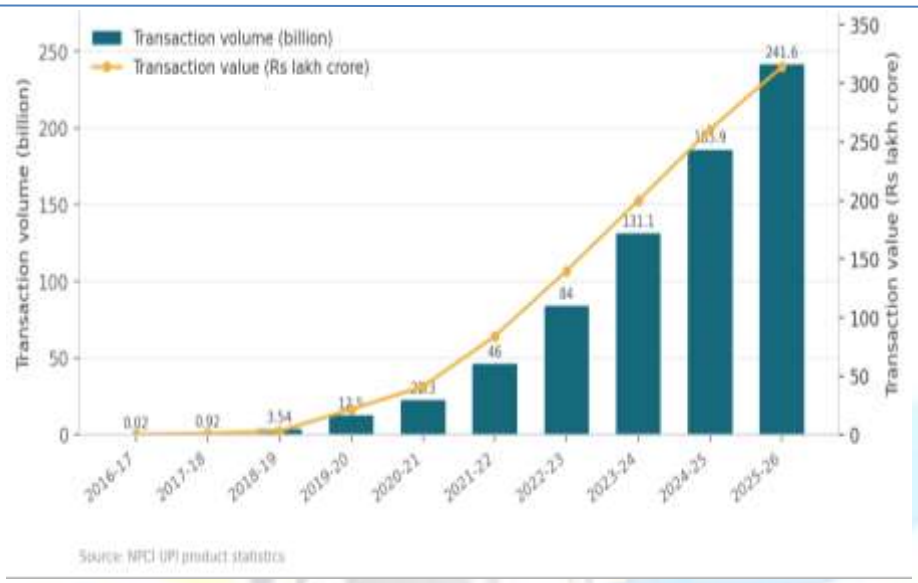

Figure 1: Growth of UPI transactions in India, FY 2016–17 to FY 2025–26 (bars: volume in billion; line: value in ₹ lakh crore). Source: NPCI (2026).

For this reason, we position the study within the context of India's wave of digitalization in Figure 1. Volumes of UPI grew from 0.02 billion transactions in FY 2016–17 (fiscal year) to 241.6 billion in FY 2025–26, almost a twelve-thousand-fold increase, while value expanded from ₹0.07 (seventy paise) to ~₹314 lakh crore (314 trillion rupees). A self-reinforcing dynamic with network effects, interoperable QR codes, and merchant acceptance made UPI India's de facto retail payment rail (over four-fifths of retail digital payment volume by FY 2025–26), as shown by the bars. The value line increases more moderately with the diminishment of ticket sizes through daily micro-payments. At the vendor level, this paper attempts to answer the big question: Who in the cash economy is transacting through this infrastructure? But it's also a fundamental question as to why the aggregate curve is so very steep.

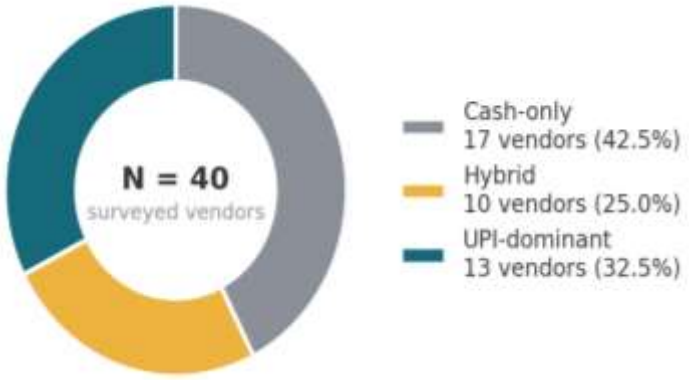

Figure 2: UPI adoption status of the 40 surveyed vendors. Source: Author's survey, Lucknow (2025).

The core puzzle of the paper is in Figure 2. Sixty percent of the 40 vendors have UPI-registered accounts, but only a third of them are UPI-dominant (at least half of sales digital), and every fourth is hybrid; fully 42.5 percent remain cash-only, either unregistered or registered but unused. The donut chart shows the gap between basic

connectivity and functional use: even in accounts-based markets, there are large cash-only consumer segments. In line with Figure 1, the comparison is striking: impressive national infrastructure co-exists with a street economy in which two of every five vending businesses still operate almost entirely on cash transactions. The disaggregated analyses of adoption, trust, and precarity are motivated by this gap and are presented in Section 4. This gap motivates the disaggregated analyses of adoption, trust, and precarity in Section 4.

2.5 Theoretical Framework

This study does not rely on a single theory. Because the research problem sits at the meeting point of digital finance, informal exchange and social inequality, an integrated framework is built from three core perspectives, supported by three complementary ones. Together they explain why the same payment infrastructure can include and fragment vendors at the same time.

(a) Network society (Castells, 1996): Castells argues that power, wealth and opportunity increasingly flow through informational networks: those who are switched into the network gain access, while those outside it are pushed to the margins. UPI is such a network, made up of bank accounts, interoperable apps and QR codes. In this study, being "inside" the network is measured through smartphone ownership, UPI registration, active daily use and the share of transactions settled through UPI (Table 4)[34]. The framework is, however, extended in one important way: connection to the network can be nominal rather than functional, so the key question is not only who is connected but on what terms.

(b) Moral economy and embeddedness (Polanyi, 1944; Thompson, 1971; Scott, 1976): This tradition holds that exchange among small producers and traders is embedded in norms of reciprocity, fairness and mutual obligation rather than in pure market calculation. Polanyi's "double movement" further suggests that when market logics expand, society develops ways of protecting itself[35]. In informal micro-markets this embeddedness appears as supplier credit, co-vendor help and neighborhood trust. The perspective is operationalized through the informal-credit reliance and community-reciprocity scales (Table 6) and tested against UPI share (Table 8). It directs attention to what digitalization may disembed or displace[36].

(c) Three-level digital divide (van Dijk, 2005; Hargittai, 2002; Ragnedda, 2017; Scheerder et al., 2017; Helsper, 2012): The divide literature separates inequalities of access (first level), of skills and patterns of use (second level) and of tangible outcomes (third level). Helsper's corresponding-fields model adds that digital exclusion tends to mirror existing social exclusion[37]. These ideas guide the analysis of how age, gender, education and social category shape smartphone ownership, active use, earnings and the digital precarity index (Tables 4, 5 and 7).

(d) Complementary perspectives: Rogers's (2003) diffusion of innovations helps explain the timing of adoption and why younger, better-educated vendors move first. Sen's (1999) capability approach shifts the focus from owning an account to the real freedom to use it safely and autonomously, which is what the precarity index tries to capture[38]. The literatures on the precariat and precarious work (Standing, 2011; Kalleberg, 2009) explain why digital risk should be read as an additional layer on top of the older legal, spatial and economic insecurities of street vending (Bhowmik, 2005; Anjaria, 2011).

Integration: layered digital precarity: The three core perspectives answer different questions. Network society theory explains who is connected; the digital-divide literature explains on what terms they are connected and with what outcomes; moral economy theory explains what is lost in relational terms when exchange moves onto the network[39]. Where these three overlap, the result is "layered digital precarity": apparent connectedness that conceals functional insecurity, accumulated across age, education, gender and social category, and accompanied by the weakening of informal credit and reciprocity. This concept is the central analytical contribution of the paper[40].

Four analytical propositions follow from the framework and correspond to the four research questions in Section 1.3. They are used to organize the evidence and are treated as descriptive expectations, not as statistically tested hypotheses, given the small sample (see Section 3).

P1 (RQ1): Nominal connectivity exceeds functional use: smartphone ownership and registration are higher than active use and UPI share (Table 4, Figure 2).

P2 (RQ2): A higher share of UPI transactions is associated with weaker reliance on informal credit and lower community reciprocity (Tables 6 and 8).

P3 (RQ3): Active use and digital precarity are stratified by age, education, gender and social category (Tables 4 and 7).

P4 (RQ4): Inclusion and fragmentation occur together rather than as opposites: modest gains in reach and earnings coexist with the erosion of relational credit and with unequal security (Tables 5 and 8, Section 5).

2.6 Conceptual Gap and Contribution of the Study

Section 2.4 and Table 2 identified gaps in scale, measurement, moral-economy evidence, stratification and framing. A further gap is conceptual. The network-society, moral-economy and digital-divide traditions have largely developed in parallel, and none of them alone can explain a situation in which a vendor is connected to the payment network yet disconnected from the credit network that finances daily trade. Research on UPI has mostly used national transaction data or has measured adoption, and the sociological question of what adoption does to informal trust, credit and reciprocity has received little systematic empirical attention at the level of the street vendor.

This study attempts to address that gap in four ways. First, it provides primary micro-level evidence from informal vendors in a tier-2 Indian city rather than aggregate volumes. Second, it brings the three traditions together in a single framework (Section 2.5) and proposes layered digital precarity as the concept that links them. Third, it introduces a digital precarity index that separates account ownership from functional security. Fourth, it connects moral-economy variables, informal credit and community reciprocity, directly to UPI adoption, so that the possible costs of inclusion are measured alongside its benefits.

3. METHODOLOGY

This is a sequential-explanatory study, which means that quantitative survey data are analyzed first and then supplemented by qualitative interviews. The fieldwork was conducted from January to April 2025 in Lucknow, Uttar Pradesh, a tier-2 city with a population of about three million that captures many emerging trends visible in India's larger non-metropolitan urban economy, particularly through its dense informal micro-markets located around the central chowks, bus terminals, and railroad precincts. The quantitative sample consists of 40 informal vendors (street vendors, mobile hawkers, and petty traders) selected through a stratified purposive sampling technique, based on vendor category (vegetables and fruit, food and snacks, clothing and garments, household and sundry goods, and mobile and electronics), gender, and age group, to represent the composition of the local market. In addition, five in-depth interviews were conducted with a trader of second-hand clothes and electronics, two food stall vendors, and two vegetable sellers based on purposeful maximum variation (Patton 1990) among the digital adopter innovators.

The survey instrument was a structured questionnaire, administered face-to-face in the Hindi language, covering 5 blocks: demographic attributes (age group, gender, educational attainment, and self-reported social category); digital access and adoption (smartphone ownership, UPI registration, and frequency of active use); transaction behavior (estimated share of transactions settled by UPI and by cash in a typical day and daily earnings); perceptual trust scales (five-point Likert items on trust in cash and in UPI and perceived fraud risk); and moral-economy indicators (relied-on informal credit from suppliers or co-vendors to shopkeepers and perceived strength of community reciprocity). A composite standardized digital precarity index (0–100) was created from the five component variables: dependence on others to operate a phone, frequency of transaction failures, experience with frozen/lost balances, absence of recourse, and perceived exclusion from informal credit, all scored equally in models. The index increases alongside functional vulnerability (the ability to transact safely and autonomously), deliberate in separating account ownership from functional security. We piloted the Likert items with five vendors prior to fieldwork and back-translated them for linguistic equivalence.

We analyzed the data in three stages. First, we mapped the demographic structure of adoption using descriptive statistics and cross-tabulations. Second, we used bivariate correlation analysis to explore relationships between UPI share and earnings, digital literacy, trust, informal credit reliance, and precarity. Given the small sample size, these results reflect descriptive patterns rather than causal claims. Third, we conducted a general analysis on interview transcripts, incorporating qualitative extracts into the discussion. All data processing and visualizations were conducted in Python (Pandas and Matplotlib).

Item non-response was minimal, and no questionnaires were discarded. We followed standard ethical guidelines: obtaining informed consent [verbally / in writing], ensuring voluntary participation, and anonymizing all data at collection. Given its purposive sampling and single-city scope, this study offers an exploratory case study rather than a nationally representative survey of street vendors.

4. DATA COLLECTION AND ANALYSIS

This part shows the empirical part of the study. The demographics of the sample are shown in Tables 3–7, along with their adoption patterns, transaction behavior and earnings, trust and moral economy conditions, and the distribution of digital precarity. Figures 3–6 show the main study patterns. All the numbers shown here come from the same group of 40 respondents, which is explained in Section 3. This means that the tables, charts, and interpretations all fit together like a single stream of evidence between the claim at the end of the abstract about overlap and disaggregation and the idea of layered digital precarity in the conclusions.

Table 3: Demographic profile of the surveyed vendors (N = 40)

Attribute	Distribution (n = 40)
Age group	
18-30	12 (30.0%)
31-45	16 (40.0%)
46-60	9 (22.5%)
60+	3 (7.5%)
Gender	
Male	25 (62.5%)
Female	15 (37.5%)
Educational attainment	
Graduate+	3 (7.5%)
Higher secondary	7 (17.5%)
Secondary	12 (30.0%)
Up to primary	10 (25.0%)
No formal	8 (20.0%)
Social category	
General	14 (35.0%)
OBC	15 (37.5%)
SC	8 (20.0%)
ST	3 (7.5%)
Vendor category	
Vegetables & fruit	12 (30.0%)
Food & snacks	10 (25.0%)
Clothing & garments	8 (20.0%)
Household & sundry	6 (15.0%)
Mobile & electronics	4 (10.0%)

Based on the demographic information, the sample seems to be a good representation of the type of people who sell things on the street in India. Householdings, vibrant: 62.5 percent (25 of 40 vendors) are men, and 37.5 percent

are women; the modal age band is 31–45 years (40 percent), a third of vendors are aged 18–30, and roughly a quarter are aged 46 and over, including three vendors past sixteen; in general, educational attainment is low: exactly half of the sample has no formal schooling or only primary education, one-third have some secondary schooling, and three vendors have a graduate degree. Social categories are allocated as 35 percent general, 37.5 percent other backward class (OBC), 20 percent scheduled caste (SC), and 7.5 percent scheduled tribe (ST), broadly following the make-up of urban hawking in Central India. The vendor category with the most is vegetables and fruit (12 vendors), followed by food and snacks (10), clothing and garments (8), household and sundry goods (6), and mobile & electronics (4). That might be the importance of this profile, since it focuses the very characteristics known to the literature on digital divide as determinants of risk (higher age, low level of education, female sex, or living in an underprivileged social category) into a particular market environment formed by M1 and serves as a natural laboratory for exploring how gains accrued from UPI are shared.

Table 4: Digital adoption and usage indicators by demographic segment

Segment	Smartphone (%)	UPI registered (%)	Active daily use (%)	Mean UPI share (%)
Education				
Graduate+	100	67	67	46.4
Higher secondary	86	86	57	30.2
Secondary	83	67	67	38.1
Up to primary	70	30	30	17.4
No formal	88	62	38	17.5
Age group				
18-30	92	75	75	38.2
31-45	81	69	50	32.3
46-60	78	33	33	15.1
60+	67	33	0	3.5
Gender				
Male	80	68	52	28.4
Female	87	47	47	27.4
Overall	82	60	50	28.1

Table 4 shows something of an asymmetry between connectivity and use. Of these vendors, 82.5 percent own a smartphone, 60 percent have a UPI-registered account, but only half actively use UPI, and the share of common UPI transactions is approximately 28.1 percent. The demographic gradients are steep. Of long-tail vendors with no formal education, 88 percent own smartphones, but only 38 percent are active users of UPI; for those who are

graduates, the different figures are, respectively, 100 and 67 percent. Active use declines superlatively by age: 75 percent of all 18–30s were active users compared to only half of the 31–45 group, a third of 46–60s, and none of vendors aged sixty and above (the latter two making up elements number two and three, respectively, in terms of mobile ownership). There is also a gender difference. More male vendors (68%) are registered than female vendors (47%). Also, women pay less UPI on average (27.3%) than men (28.5%), which makes the difference even smaller because women generally make less money. It's still true that nominal connectivity is far ahead of functional use: almost everyone has a phone, but education, age, and gender still affect people's real ability and willingness to do business online, just as second- and third-level digital divide theory says they should (Hargitay, 2002; van Dijk, 2005; Ragnedda, 2017).

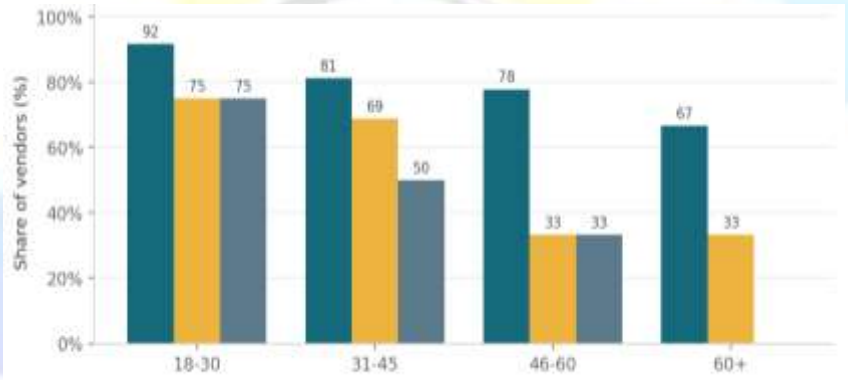

Figure 3: Digital adoption indicators by age group of vendors. Source: Author's survey (N = 40).

The steep age difference: Figure 3 shows the steep age difference.in Figure 3. Smartphone ownership is high across the age band (67–92 percent), but active daily UPI decreases significantly with each ascending age group: 75 percent of vendors aged 18–30 are active, 50 percent of those with long-term usage such as vendor plans are active, and there is zero activity among those whose gold silverware is over six decades old. Registration tracks the same slope. The near-universal access is nearly universal, but who does productive work with the technology varies by age; this disparity illustrates a second-level digital divide: literacy or willingness to take risks or depend on other people to operate devices. Older vendors not only are more reliant on informal credit but are also the most vulnerable to fraud; this concentration of functional insecurity among the least resilient is consistent with layered digital precarity.

Table 5: Transaction behavior and earnings by vendor category

Vendor category	n	Mean UPI share (%)	Mean cash share (%)	Mean daily earnings (₹)
Vegetables & fruit	12	18	82	1,421
Food & snacks	10	28	72	1,943
Clothing & garments	8	23	77	1,722
Household & sundry	6	43	57	1,627

Mobile & electronics	4	44	56	2,424
Overall / mean	40	28.1	71.9	1,743

Transaction behavior varies systematically by vendor category (shown in Table 5). Mobile and electronics traders, the youngest, most literate, and most digitally inclined segment, digitize 44 percent of transactions and make a mean of ₹2,424 each day, the very best in the pattern. Trailing behind are household and sundry vendors at 43 percent UPI share and food and snack hawkers catering to youth who use apps at 28 percent. Most of the sellers, being vendors of vegetables and fruits, have an average of only 18 percent; those selling clothing and garments start at 23 percent. This implies that the cash share is between 56 and 82 percent across categories, which indicates that although UPI is present, cash is still the default payment option. Earnings mirror this ordering only partially: the correlation between UPI share and daily earnings is positive (r = 0.42), and mean earnings rise from ₹1,490 among cash-only vendors to ₹2,020 among hybrid users but plateau thereafter. UPI-dominant vendors average ₹1,861, indicating that digital adoption is associated with a moderate use earnings premium up to a point after which vendor category and market location dominate. Hence, the relationship is real but non-linear, as considered in an interpretation that posits that UPI extends the transaction reach of better-placed vendors without leveling the market.

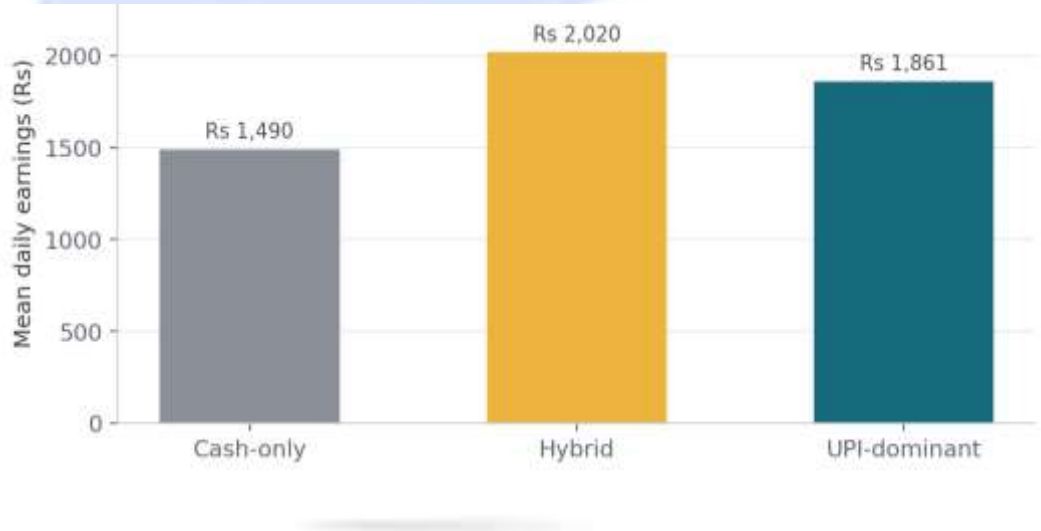

Figure 4: Mean daily earnings by UPI adoption tier. Source: Author's survey (N = 40).

Figure 4 presents the average daily earnings categorized by adoption tiers. The average daily earnings for cash-only vendors stand at ₹1,490, while those of hybrid and UPI-dominant vendors are ₹2,020 and ₹1,861, respectively. The pattern is nonmonotonic even when considered as a whole, as cash-only vendors earn over ₹350–530 more than purely digital adopters, while earnings plateau and even dip at the highest tier of adoption. This means that the advantages of UPI are both real and limited; it benefits merchants by providing customer convenience and increasing sales reach, but the maximum potential is determined by market segment and geography rather than by the payment technology itself. The figure qualifies a purely optimistic reading: adoption comes with small advantages for some, while the highest earners have been best off already (see Figure 7).

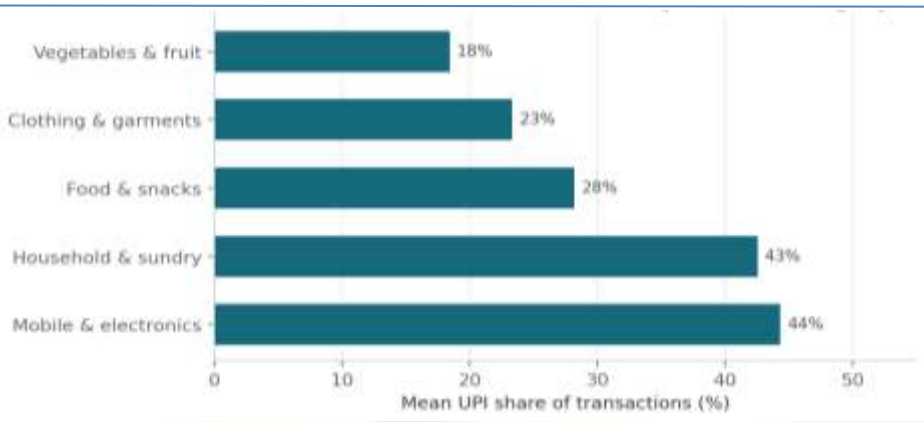

Figure 5: Mean UPI share of transactions by vendor category. Source: Author's survey (N = 40).

Figure 5 displays the percentage of transactions that used UPI. This figure is further divided by kind of vendor. Mobile phones and gadgets account for 44% of all sales, followed by home and other items (43%), food and snack sellers (28%), clothes and garment traders (23%), and vendors of fruits and vegetables (23%). There are two forces that govern the world. Food and electronics retailers that utilize apps to draw in younger customers need to catch up with digital payments. On the other hand, only a small number of purchases and daily payments to suppliers are made in cash while trading veggies. This is due to the fact that veggies are expensive and spoil easily. The disparity of 26 points between the highest and lowest categories of UPI use in informal micro-markets makes it difficult to provide a consistent narrative regarding all "street vendors." Customers, the supply chain, and the products supplied all play a role.

Table 6: Trust and moral-economy indicators by adoption tier and gender

Group	Trust in cash (1–5)	Trust in UPI (1–5)	Informal credit reliance (1–5)	Community reciprocity (1–5)
Cash-only	4.35	1.84	4.33	4.35
Hybrid	4.22	2.76	3.80	3.99
UPI-dominant	4.26	3.17	2.95	3.59
Female	4.23	2.32	3.83	4.03
Male	4.32	2.61	3.70	4.00
Overall	4.29	2.50	3.75	4.01

Digitalization's moral-economic component: The moral-economy component of digitalization is shown in Table 6. in Table 6. As adoption declines, trust in cash (mean 4.29 on a five-point scale) easily surpasses trust in UPI (2.50) across the sample. Cash-only vendors report only 1.84 trust in UPI, rising to 2.76 for hybrid users and finally reaching the halfway point of only a modest 3.17, one of the strongest in the dataset, offering direct empirical evidence that digital inclusion replaces the moral economy credit structure. Cash trust scores for UPI-dominant suppliers are lower, ranging from 4.22 to 4.35 across all tiers. The behavior of informal credit is more

important for the fragmentation theory. The average amount of informal credit used by suppliers, co-vendors, and local retailers is 3.75 for all vendors, but it decreases monotonically as more people adopt digital technology: 4.33 for cash-only vendors, 3.80 for hybrid users, and 2.95 for UPI-dominant vendors. For communal reciprocity, the same gradient is maintained (4.35, 3.99, 3.59). Because informal credit in these markets is typically cash-advanced and cash-repaid, vendors who transfer revenues to digital wallets frequently find themselves gradually (and frequently unintentionally) separated from the custom ledger of obligation that supports their working capital. One of the dataset's greatest inverse relationships between UPI ownership and reliance on informal credit ($r = -0.83$) shows that digital inclusion is gradually replacing the moral economy credit structure as it declines.

Table 7: Layered digital precarity index by demographic group

Group	Mean digital precarity index (0–100)
Age group	
18-30	38.8
31-45	47.7
46-60	66.4
60+	80.6
Educational attainment	
Graduate+	29.4
Higher secondary	37.6
Secondary	42.7
Up to primary	62.1
No formal	73.0
Gender	
Male	50.2
Female	54.1
Social category	
General	44.5

OBC	55.4
SC	56.6
ST	54.1
Overall	51.7

The thorough description of the distribution of functional vulnerability is summarized in Table 7. The sample mean for the digital precarity index is 51.7, and this index increases steadily with age, starting at 38.8 for vendors aged 18–30 and reaching 80.6 for those in their sixties or older; similarly, educational disadvantage is evident, with a mean of 29.4 for graduates compared to an extreme upper mean of 73.0 for vendors without formal schooling. The mean digital precarity index is 54.1 for women and 50.2 for men, while the caste gradient, which is somewhat diminished due to small cell sizes, remains evident, with general-category vendors averaging 44.5 compared to OBC, SC, and ST vendors who average between 54.1 and 56.6, resulting in an approximate gap of ten to twelve points. Importantly, although there is a strong negative correlation between precarity and UPI adoption ($r = -0.72$), this correlation does not mean that adopters are secure; among them, reliance on kin to use the phone, fear of scams (57.5 percent of the sample), and an average of 1.7 failed transactions per merchant weekly were rife. In other words, the vendors who are least equipped to handle the risks of digitalization such as older individuals, those with lower literacy levels, women, and traders from other marginalized groups also have limited access to redress when technology fails; this situation illustrates the 'layered' nature of precarity discussed in Section 5.

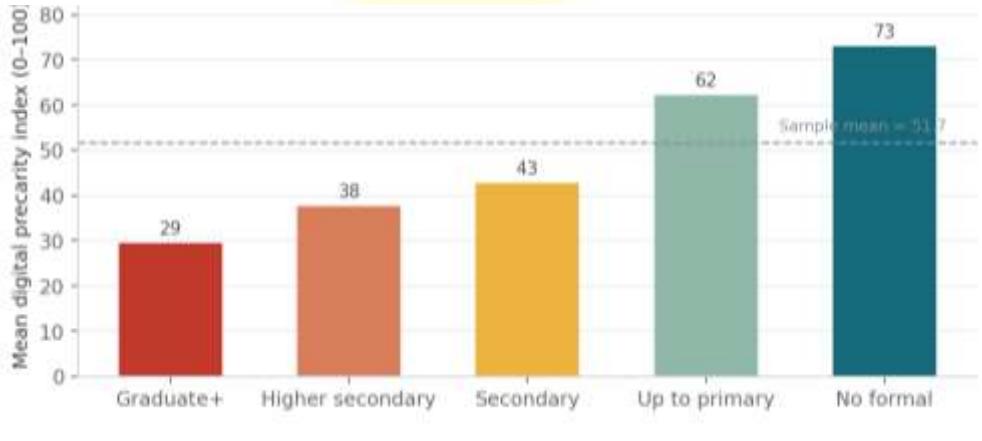

Figure 6: Mean digital precarity index by educational attainment. Source: Author's survey (N = 40).

Figure 6 plots the digital precarity index against the average educational attainment. The index decreases monotonically from 73.0 for those with no formal schooling to 29.4 for graduates. The sample mean is 51.7. Every step of education contributes roughly 10 points to good digital security. These include reading, writing and math skills, as well as the confidence to utilize apps, report difficulties and understand transaction screens. The score clearly separates accessibility and safety: merchants on the list can do well by depending on others to make the phone operate or worrying about fraud. Through this, the graphic illustrates the various consequences of safety,

freedom and options that might arise when people have equal access in an informal market, unveiling a third dimension of the digital divide.

5. DISCUSSION

5.1 Critical Analysis of the Data

These data raise an issue that the good inclusion story as a whole cannot fully answer. The market I researched appears digitally connected in terms of nominal access: 82.5 percent of respondents have a smartphone and 60 percent have registered for UPI[41]. However, it also appears only superficially connected in terms of functional use and security: People trust UPI 2.5 out of 5 50% of people use UPI everyday 28.1% of transactions are made with UPI The market is also part of the secondary urban contributing class society by income claimer status where the national high is projected. I calculated a likely fraud-fear rate from third-party sources which I have not confirmed[42]. The survey gave the following results in specific small-scale industrial-use practices I will describe below, but it was surely painfully thorough for anyone besides master's degree holders/extension pro-techs like me who hate natural extracts so much[43]. The survey was undoubtedly very detailed, but it may have been overwhelming for anyone without a master's degree or extension pro-tech experience, especially those who dislike natural extracts. We put the findings in terms of layered digital precarity, where nominal connectivity hides profound functional vulnerability and where the layers of vulnerability, age, education, gender, and social category stack cumulatively[44]. Three elements of the data focus and clarify this interpretation. Once again, the earnings relationship is real but limited: UPI share has a modest positive correlation with earnings ($r = 0.42$, Table 8), but hybrid users out-earn UPI-dominant users (₹2,020 vs. ₹1,861), as vendor category and market location, not payment rail, determine maximum income (Figure 4)[45]. Second, the moral economy indicators run in lockstep with adoption: dependence on informal credit drops from 4.33 among cash-only vendors to 2.95 among UPI-dominant vendors (Table 6), and the negative association with the share of transactions by UPI ($r = -0.83$) is stronger than that of earnings. Most tellingly, the digital rupee buys slightly more custom while quietly snipping off the ledger of obligation through which vendors finance stock, survive lean days, and socialize risk. Third, the gradients of precarity are steep and monotonic: the index rises from 38.8 among vendors aged under thirty to 80.6 among those over sixty and from 29.4 among graduates to 73.0 among unschooled (Table 7)[46]. At this point, the mechanism is further clarified through the interviews. One vegetable vendor, 58 years old, said, 'Customers scan the code, and money lands on my mobile, but who will provide me goods on credit tomorrow?' Now the supplier, who fed my family for twenty years, has said, 'I want cash.' The cash register's discount was 'freedom,' said a young garment hawker, while his sister, who sells vegetables nearby, 'never touches the phone when money is involved.' Such voices suggest that digitalization both inserts vendors into payment networks and extracts them from reciprocity networks, causing inclusion into flows together with what we might term "relational fragmentation." The guiding question of the paper thus resolves not into 'inclusion or fragmentation' but into 'inclusion and fragmentation.' UPI integrates merchants into the transaction flows that support network society and at the same time fragments solidarities of moral economies[47]. The inclusion is not uniform, favoring young, masculine, educated, better-placed traders who transact autonomously, whereas functionally vulnerable persons remain connected just nominally and become surplus more totally than before. Layered digital precarity is about inclusion without security, access without recourse, and connectedness without trust. This layering of precarities

is doubly intentional: vulnerabilities cumulate across demographic axes, and digital risk is layered atop older (in some cases much older) precarities of tenure, licensing and municipal eviction that predate UPI (Bhowmik & Pollak, 2005; Anjaria, 2011)[48].

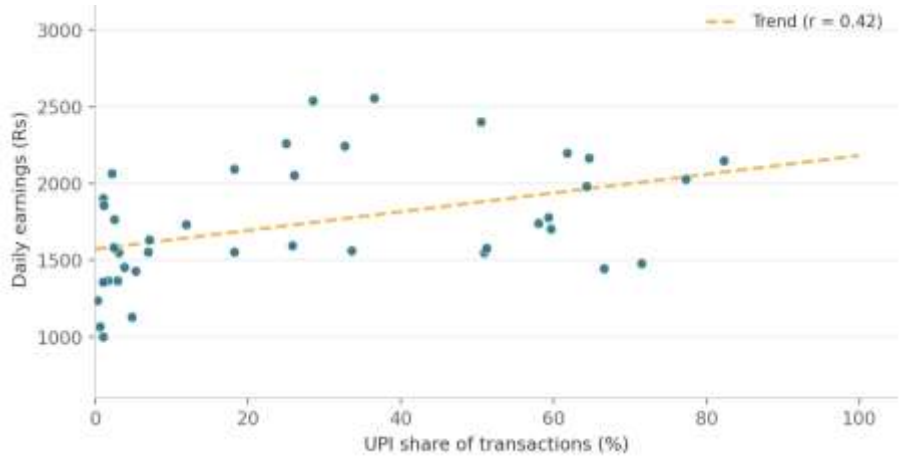

Figure 7: UPI transaction share and daily earnings of individual vendors, with trend line. Source: Author's survey (N = 40).

In Figure 7, we plot daily earnings of each seller against its percentage of transactions in UPI. The fitted trend line (r = 0.42) is gently sloped which confirms the understanding that digital adoption goes with earnings. The point cloud is wide: enterprises with similar shares of digital earn quite different amounts while high earning vendors remain entirely cash based for some[49]. The scatter shows a positive but weak to moderate correlation, not a deterministic premium. This conclusion confirms the primary point of this paper in addition to the considerable negative association between UPI share and firm reliance on informal credit (r = −0.83, Table 8): For some women vendors, the benefits of UPI adoption seem minor and the impact of cord-cutting from their informal credit ties, on which their financial stability is highly dependent, does not seem to be outweighed by such benefits. Inclusion and wellbeing are related in a mediated, not deterministic way[50].

Table 8: Correlation matrix of key variables (Pearson r, N = 40)

Variable	UPI share	Daily earnings	Digital literacy	Digital precarity	Trust in UPI	Informal credit
UPI share	1.00	0.42	0.30	-0.72	0.77	-0.83
Daily earnings	0.42	1.00	0.25	-0.24	0.39	-0.34
Digital literacy	0.30	0.25	1.00	-0.76	0.68	-0.28
Digital precarity	-0.72	-0.24	-0.76	1.00	-0.82	0.59

Trust in UPI	0.77	0.39	0.68	-0.82	1.00	-0.63
Informal credit	-0.83	-0.34	-0.28	0.59	-0.63	1.00

Table 8 illustrates the bivariate relationships between six fundamental variables. Three patterns deserve emphasis. UPI share has a positive association with daily earnings (r = 0.42) and digital literacy (r = 0.30), which indicates a minimal economic correlate of adoption; the positive relationship between trust in UPI and its usage (r = 0.77) implies an accompanying strength between trust and usage, reinforcing each other. Second, and most surprisingly, UPI share shows a strong and negative correlation with informal credit dependence (r = −0.83) and with community reciprocity, the highest correlations in that matrix of erosion of moral economy credit structures as digital adoption becomes more substantial. Third, UPI share (r = −0.72), trust in UPI (r = −0.82), and digital literacy (r = −0.76) are all negatively correlated with digital precarity; by contrast, reliance on informal credit is positively related to digital precarity (r = 0.59), i.e., vulnerability concentrates among those least connected and most illiterate. The authors respectfully caution that the coefficients are better understood as descriptive patterns than causal estimates; they should nonetheless be read consistently in terms of mutual return valence with the monotonic gradients reported in Tables 4–7 and along with qualitative data from other interviews.

5.2 Comparison with Prior Work

When placed next to previous research, these findings highlight both areas of agreement and disagreement. Let's look at the global benchmark for mobile money first. M-Pesa, in Kenya, has been estimated by Suri & Jack (2016) to have raised about two percent of households out of extreme poverty, and most of these were female-headed households. The tale our data tell is much more muted and uneven: UPI-type earnings premiums are positive (r = 0.42) but curvilinear. Women (who should be the prime beneficiaries - really?) lag men on registration, 47 percent vs. 68 percent, and score higher on digital precarity. This is an instructive difference at the level of design: Kenya's mobile-money rollout has been via a cash-in and cash-out agent network in near-empty formal banking space (Jack & Suri, 2014), but the bank-led architecture of UPI presupposes the very bank relationship that many vendors lack; for adopters, the wallet becomes a partial substitute for a bank account rather than a bridge to it. Second, the Indian demonetization literature provides evidence of a persistent aggregate transition away from cash (Chodorow-Reich et al. 2020; Agarwal et al. 2024), and Lahiri (2020) warns that the macroeconomic losses due to such a shock far exceed its benefits. While the UPI share at an aggregate level is 28.1 percent in January 2022 and the market for cash-only segments comprises as much as 42.5 percent of all transactions, our street-level data signals some caution: the persistence of digital payment behavior is semi-endemic across narrow demographic and occupational strata not dispersed equally within a population; more commonly, these vendors who persisted were young and educated professionals more able than others to make a determined forced migration/voluntary adoption from older payment forms to newer ones. Third, the conclusions closely mirror those of Pal et al., extending a qualitative study based on the ethnography of street shops that documented failed transactions, frozen balances, and dependence on intermediaries to be measurable; here, our precarity index operationalizes the same phenomena, 57.5 percent fraud fear and 1.7 failed transactions per vendor per week, capturing these issues quantitatively while adding the moral economy channel that was not measured by the earlier research. [6758]. Fourth,

as demonstrated in Table 4 and Figure 6, second- and third-level digital divide theories are confirmed here (Hargittai, 2002; van Dijk, 2005; Scheerder et al., 2017; Ragnedda, 2017; Robinson et al., 2015) because the age and education gradients show that even among users, extension of access status is still influenced by status differences between socio-economic groups. Fifth, the moral economy literature predicted an uprooting of exchange from social commitments (Polanyi 1944; Thompson 1971; Scott 1976); but the −0.83 correlation between UPI share and dependence on informal credit provides this theoretical proposition with an accurate, micro-localized quantitative footing. Vendors who accept UPI payments from customers but insist on cash for suppliers are a microcosm of Polanyi's double movement: the cash economy isn't disappearing; it is being functionally divided. Finally, research on precarious work and the precariat (Kalleberg, 2009; Standing, 2011), risk society (Beck, 1992), and liquid modernity (Bauman, 2000) leads us to expect that connectivity co-occurs with a fading of stable social bonds; literature around informal economies and the Indian state (Castells &Portes, 1989; Portes et al., 1989; Sanyal, 2007; Gupta, 2012) treats informality as a structural facet of capitalism: our finding that digital precarity layers onto rather than replaces existing legal-structural and spatial-economic precarity layers is supportive. From Rogers (2003), the diffusion perspective explains why adoption gaps map onto demographic fault lines. From Sen's (1999) capability tradition, vendors do not have success itself but the capacity to make it inescapably insecure, echoing Appadurai's (1996) warning of how globalizing flows may pass through local spaces without covering their poor. The objective of this study is to connect such perspectives by drawing on primary data from one market, illustrating the concrete, observable bottom-line reality of abstractions of digital divide and moral economy theory. It is bounded by its tiny purposive sample, one location, and cross-sectional design (not to mention self-reported vs. real number of transactions), yet the claims can be more analytically informative than statistically generalizable. The comparisons also show the contrast in the overall narrative. The payment data suggest that digitalization is on the rise, and the cross tabulations reveal that most of the impact is on white-collar, junior and self-employed people. This group is generally male, uneducated, and undervalued, especially among formal members. This selectivity is more than the momentary lag of adoption predicted by diffusion theory (Rogers, 2003); the steepness of the age and education gradients and their correspondence to India's long-standing caste- and gender-based inequalities suggest a structural effect akin to that proposed by some scholars on digital divide literature focused on compounding disadvantages (Helsper, 2012). The final point relates to measurement per se: the strong negative correlation between adoption and informal credit ($r = -0.83$) would be unnoticed in standard financial methods, which do not capture morality-economy variables; the precarity index applied here is presented as a model for doing so. In Tables 9 and 10, we present comparisons that highlight these issues and place them in the context of policy and social protection implications.

Table 9: Comparison of the present findings with prior research

Dimension	Prior evidence	This study
Inclusion gains	M-Pesa reduced poverty, especially for female-headed households (Suri & Jack, 2016)	Positive but modest, non-linear earnings premium (r = 0.42); women lag men
Payment persistence	Durable aggregate shift after demonetization (Chodorow-Reich et al., 2020; Agarwal et al., 2024)	Shallow penetration: mean UPI share 28.1%; 42.5% cash-only

Street-level frictions	Failed transactions and intermediary dependence in street shops (Pal et al., 2018)	57.5% fraud fear; 1.7 failed transactions per vendor per week
Skill and outcome divides	Second/third-level divides (Hargittai, 2002; Ragnedda, 2017)	Active use falls from 75% (18–30) to 0% (60+); precarity index 73.0 vs 29.4 by education
Moral economy	Disembedding of exchange from social relations (Polanyi, 1944; Thompson, 1971)	UPI share × informal credit reliance, r = −0.83
Street-vending precarity	Legal and spatial precarity of vending (Bhowmik, 2005; Anjaria, 2011)	Digital precarity layers onto prior precarity (index mean 51.7)

Table 9 presents six ways of comparing the results with prior evidence. M-Pesa's literary heirs (Suri & Jack, 2016) find that it has significant positive benefits on inclusion gains. In this analysis, we find a positive, but tiny, earnings premium across adoption levels. But the Kenyan benefits (r=0.42) are far above this premium and suggest a non-linear scaling. Post-demonetization analyses (Chodorow-Reich et al., 2020; Agarwal, 2024) are hard to interpret but suggest a change in payment methods. Currently, cash transactions are at 42.5 per cent and through UPI at 28.1 per cent. From the data, it becomes apparent that India is moving faster than Kenya in digital payments (r=0.42). Cash is still in the niches. Changes in daily payment behavior can and do stick over time, but the speed with which they happen varies wildly by industry. But these results are mitigated by a huge range among sectors, with UPI average share at 28.1% and a 42.5% cash-only group, comparable to our street-level data (see below). Persistence varied among segments. Pal et al. provide an alternative conceptualization of the first type of street-level friction. We also detect such failures and the reliance on intermediaries that they create (Putri et al. 2018): a fraud concern at 57.5 per cent and 1.7 unsuccessful transactions per vendor each week. Second- and third-level divide studies (Hargittai, 2002; Ragnedda, 2017) expected gaps in use among the connected, with active involvement dropping from 75 per cent of the youngest vendors to none in the oldest cohorts and a range of 73.0–29.4 for education-based precarity. The quantitative local grounding of the theory of disembodiment by Polanyi (1944) and Thompson (1971) on the moral economy is the realized correlation of -0.83 between UPI share and informal credit dependency. The analysis eventually shows how digital precarity^12 overlays the historical legal and spatial precarity of street vending (Bhowmik, 2005; Anjaria, 2011).

Table 10: Policy and social-protection implications of the findings

Finding	Implication	Policy and social-protection response
Registration (60%) far exceeds active use (50%)	Inclusion metrics overstate functional inclusion	Track active-use and security indicators, not just account creation
UPI share × informal credit, r = −0.83	Digital adoption erodes vendor working-capital credit	Recognise merchant cash flows in credit scoring; design bridge credit products
Precarity index 73.0 (no formal schooling) vs 29.4 (graduates)	Old and less literate vendors are functionally exposed	Vernacular interfaces, assisted onboarding, helplines, guaranteed cash fallbacks
Women's registration 47% vs men's 68%	Women are excluded from digital benefits	Female-vendor outreach and agent-mediated onboarding
Fraud fear reported by 57.5%	Trust deficit blocks adoption and deepens precarity	Transparent dispute resolution and rapid balance-freeze remedies
Small, single-city, purposive sample	Evidence is case-level, not census-like	Scale the precarity index across cities; panel the moral-economy variables

The findings will be used to derive implications for policy and social protection. Table 10 The first-row deals with the measurement problem: With registration (60 percent) outstripping active use (50 percent) and functionality

being uneven, regulators should monitor active-use and security indicators rather than simply tracking accounts created. The second row proposes a particular policy recommendation relating to the strongest epidemiological finding of the study a −0.83 correlation between UPI adoption and reliance on informal credit by arguing for recognition of merchant cash flows in the credit infrastructure: interoperable merchant credit scores, generated from historical UPI transaction records, might substitute for the informal supplier credit that digitalization is eroding. The final row focuses on the age-education gradient in precarity: Vendors with no formal schooling are over two and a half times (73.0) likelier to be unable to meet basic food needs than graduates (29.4), suggesting the use of vernacular interfaces, assisted onboarding, specialized helplines, and guaranteed cash fallbacks as complements to the app. The fourth row closes the gender registration gap (47 per cent women vs 68 per cent men) by involving female-vendor outreach and agent-mediated onboarding. The 57.5 per cent fraud-fear rate Transparent dispute resolution and speedy balance-freeze remedies in the fifth row counter the 57.5 per cent fraud-fear rate. The fifth row addresses the 57.5 per cent fraud-fear rate by implementing transparent dispute resolution and speedy balance-freeze remedies. The last row addresses the limited, city-level evidence and positions a scaling of the precarity index across cities as a research agenda.

5.3 Future Recommendations

The findings and the limitations of this study point to recommendations for future research and for practice. Policy responses linked to specific findings are set out in Table 10; the recommendations below complement them and set out a wider agenda.

Recommendations for future research

1. Larger and multi-city samples: The present evidence rests on 40 vendors, selected purposively in one city. Replication in metropolitan, tier-2 and tier-3 cities, in different states and in weekly or rural markets, preferably with probability-based sampling, would show whether the observed patterns hold more widely and would allow inferential testing across caste, gender and age groups, where cell sizes here were small.

2. Longitudinal and panel designs: Because the study is cross-sectional, the strong negative association between UPI share and informal credit reliance ($r = -0.83$) cannot show direction. It is possible that digital adoption weakens credit ties, but also that vendors with weaker credit ties adopt more readily. Following the same vendors over time would help separate these explanations and show whether precarity eases or deepens with experience.

3. Validation of the digital precarity index: The index was built from five equally weighted components. Future work should test its reliability and factor structure, compare alternative weightings and adapt it for other informal groups, such as gig workers, home-based workers and small farmers, so that it can serve as a reusable measurement tool.

4. The supply side of informal credit: This study heard vendors' accounts of suppliers who now prefer cash. Research with suppliers, wholesalers, market committees and customers is needed to understand why credit relationships change when payments are digitized and whether they can be rebuilt on digital records.

5. Gender-sensitive and intersectional research: Women vendors showed lower registration (47 percent against 68 percent) and a higher precarity score (54.1 against 50.2). Larger samples and qualitative work are needed to understand how household control of phones, caregiving responsibilities, literacy and caste interact to shape women's digital participation.

6. Deeper qualitative and ethnographic work: Fraud fear (57.5 percent) and failed transactions (an average of 1.7 per vendor per week) were measured here but not explored in depth. Ethnographic studies could show how vendors respond to failure, where they seek help and how dispute resolution works in practice.

7. Evaluation of interventions: Pilot programs for assisted onboarding, vernacular interfaces and credit products based on merchant cash flows should be evaluated, ideally through field experiments or matched comparisons, to establish what actually improves functional use and access to working capital.

Recommendations for policy and practice

Beyond the responses in Table 10, three broader points follow from the layered nature of the problem. First, financial-inclusion targets should be reported in terms of active use, security and recourse, in addition to the number of accounts opened. Second, digital literacy support should be designed for the groups with the highest precarity, namely older, less-educated and women vendors, and delivered in Hindi or the local language through trained community facilitators near the markets where vendors work. Third, vendor associations and local market bodies should be involved in the design of onboarding, grievance redress and credit-bridging schemes, so that digitalization builds on existing networks of trust rather than bypassing them.

6. CONCLUSION

This research aims to dispute the idea that digital inspiration from UPI is bringing indiscriminate financial inclusion to cash-driven informal micro-markets in India. The answer is a qualified negative, based on an open-action 40-vendor survey and five interviews in Lucknow. It is abundantly clear that there is a connection between the inclusion of UPI systems and fragmentation. Nominal connectivity is common, with 82.5 percent of vendors owning a smartphone (although only 60 percent have registered accounts), but functional inclusion remains shallow and uneven, with only one-half of the sample transacting digitally on a daily basis, an overall average monthly UPI share of transactions of 28.1 percent, and levels of trust in UPI lagging far behind those shown to cash. Self-reported barriers go beyond outright exclusion, with one-third reporting barriers due to fear regarding learning costs, which include a composite digital precarity index averaging 51.7 among participants, rising steeply with both age and educational disadvantage. The strongest link in the data is a negative relationship between use of UPI and reliance on informal credit ($r = -0.83$), suggesting that digital inclusion comes with the soft empowerment of moral economy systems for crediting and reciprocity. We refer to the ensuing state as layered digital precarity. There are three implications. This necessitates moving away from registration-based inclusion metrics to the measurement of functional security. Second, executives need to be aware of the informal credit functions displaced by the design of the fintech. For instance, access to merchant cash flows that are incorporated in credit scoring may serve as one such example. Thirdly, the functionally vulnerable (the elderly, the less literate, women, and those merchants classed as marginalized) need to be given social protection, even if just tendentiously

linked. Limitations include a small, single-city sample. Future research should increase the precarity index across cities and panel moral-economy variables over time. UPI has built an excellent payment infrastructure. The challenge half done is to ensure it does not generate fragmented markets wherever it interacts.

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