

UPI and the Informal Economy: A State-Level Analysis of Digital Payment Adoption and Informal Enterprise Performance in India

Vansh Gupta

The Modern School, New Delhi, India

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ABSTRACT

This paper examines the relationship between digital payment adoption and production-side outcomes among informal enterprises in India. Using state-level cross-sectional data for 37 States and Union Territories, Ordinary Least Squares (OLS) regressions estimate the association between digital payment intensity, digital payment growth, and four measures of enterprise performance: receipts per establishment, receipts per worker, gross value added (GVA) per establishment, and GVA per worker. The results indicate that higher digital payment intensity is associated with lower receipts and GVA per establishment but exhibits no statistically significant relationship with worker-level outcomes. In contrast, faster growth in digital payment adoption is positively associated with GVA per establishment but negatively associated with GVA per worker. Overall, the findings suggest that digital payment adoption is not consistently associated with improved production-side outcomes. Rather, digital payments appear to function as an enabling technology whose benefits depend on complementary improvements in enterprise capabilities, market access, and the broader business environment.

Keywords: UPI; Digital Payments; Informal Enterprises; Production-side Outcomes; India

JEL Codes: O17, E42, G21

1. Introduction

UPI was launched in India in 2016, a peer-to-peer and peer-to-merchant payment system through which users can use a single mobile application to make payments from multiple bank accounts. The government's "Digital India" program and the 2016 demonetization plan were the two main causes of the surge in popularity of UPI. By increasing Internet access nationwide, encouraging digital literacy, and providing mobile banking, digital security, and identity services, the government's Digital India initiative sought to make India a digital society. Later, the COVID-19 pandemic became another major catalyst which drove India towards a cashless society. It

increased awareness of digital transaction tools in both urban and rural areas. Movement restrictions, concerns over physical contact, and disruptions to traditional marketplaces led both consumers and small businesses to increasingly adopt digital modes of payment. As of 2025, digital payments account for over 90 per cent of the total transaction volume, and UPI alone accounts for 85 percent of digital payments.¹

Given its rapid adoption, various studies have looked into the impact of UPI on the economy. UPI's open and low-cost architecture has enabled large-scale adoption and expanded access to digital payments. Digital payments reduce informality and enhance economic efficiency, contributing to growth.² UPI reduces the psychological cost of spending, leading to higher consumption.³ However, some papers also highlight the negative aspects of UPI, such as exhibiting increasing market concentration and raising competition concerns. The expansion of UPI has increased exposure to fraud and cybersecurity risks.⁴

While there has been a growing body of work on the Unified Payments Interface, empirical evidence on its impact on the production side of the economy remains limited. Much of the existing literature that does examine production-side effects relies on firm-level analyses based on small samples, case studies, or proprietary datasets, often confined to specific regions or sectors. More broadly, studies have focused on consumer adoption, financial inclusion, and behavioural responses to digital technologies, with relatively little attention to firm-level outcomes such as sales or productivity—particularly within the informal sector. These limitations are largely driven by data constraints, including the absence of comprehensive digital payment usage data and the weak representation of informal enterprises in high-frequency datasets.

This paper addresses these gaps by providing a state-level, aggregate analysis of the relationship between digital payment penetration and informal sector performance across India. In doing so, it asks whether the expansion of the Unified Payments Interface is associated with improvements in informal sector outcomes such as establishment-level and worker-level sales and productivity. Although the empirical analysis uses total digital payment transactions, it effectively captures the expansion of UPI-led digitalisation, given that UPI accounts for a major part of retail transaction volumes in India. Consequently, the results can be interpreted as reflecting the broader impact of UPI-driven digitalisation on informal economic activity at scale.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature on digital payments and informal sector dynamics. Section 3 describes the data sources and key variables used in the analysis. Section 4 outlines the empirical specification and analysis. Section 5 concludes with a discussion of policy implications and directions for future research.

2. Literature Review

2.1 History of Digital Payments in India

Over the past decade, India has experienced a rapid transformation in its payments ecosystem, driven by the expansion of digital infrastructure and innovations such as the Unified Payments Interface. This transformation has significantly reduced transaction costs and increased the accessibility of digital payments, particularly for small and informal enterprises. Before UPI, digital payments in India were done mainly through NEFT, RTGS, and card networks, which were largely limited to urban, banked populations and had relatively high transaction frictions. The Government's Digital India initiative expanded digital infrastructure by improving internet connectivity, increasing smartphone penetration, and promoting Aadhaar-linked financial inclusion.

The 2016 demonetisation created a liquidity shock, which further accelerated the adoption of UPI. This persisted even after the supply of money had normalised and returned to previous rates.⁵ The COVID-19 pandemic further accelerated digital payment adoption due to mobility restrictions and increased preference for contactless transactions.⁶ UPI has emerged as the current dominant system for payments. Many Indian companies, such as Paytm and Bharat Pay, have been successful in spreading UPI among the masses and equipping every vendor and shop with a QR scanner.

Table 1: Total Number of Digital Transactions through Unified Payment Interface (UPI) Platform in India (2016-2017 to 2019-2020, up to January 2020)

Year	Total Digital Transactions (Rs. in Crore)	YoY Growth (%)
2016-2017	1.7	-
2017-2018	90.3	5,212%
2018-2019	539.15	497%
2019-2020*	994.6	84%

*Note: *: Up to January, 2020. Source: Rajya Sabha Unstarred Question No. 1638, dated 05.03.2020.*

2.2 Informal Sector and Digital Payments

India has a large informal sector, particularly in rural areas. This sector remains highly unregulated and unorganised, despite numerous efforts by the government to formalise it and provide workers with safer working conditions and other essential aspects of a healthy work environment. Informal enterprises typically operate outside formal systems and remain weakly integrated into formal financial and institutional structures, making them particularly responsive to changes in payment systems such as the adoption of digital payments.

Informal firms face persistent constraints, including limited access to formal finance, as the absence of verifiable records and collateral restricts their ability to obtain institutional credit.⁷ They are also heavily dependent on cash transactions, which increase transaction frictions, raise risks associated with handling physical currency, and limit their ability to scale operations.⁸ Frictional transaction costs are the additional costs which the government, firms and individuals have to bear; these could include: counting money, finding change, travelling to places to collect or give money and even the time taken to complete a transaction. Also, the fact that you can only transact in person and that there are no remote payments further aggravates the issues. This waste of resources produces leakages in the economy. Historically, digital adoption among informal enterprises has been low due to infrastructure gaps, limited digital literacy, and a lack of trust in formal financial systems.⁹

Digital payments, UPI in particular, reduce friction and increase efficiency; it is also faster and more convenient. This reduction in friction arises from the elimination of time and effort involved in handling cash, such as counting money, finding change, and completing transactions physically, thereby allowing firms to carry out a greater number of transactions in a shorter period of time. It also improves liquidity as the dependence on physical cash reduces. It can give an instant settlement, which enables firms to receive payments immediately and manage their working capital more efficiently. This is particularly important for informal enterprises that face short-term cash constraints and rely heavily on daily cash flows for their operations. It also provides detailed financial statements and transaction history, creating verifiable records of income and expenditure. These records can reduce information asymmetry and potentially improve access to formal credit by allowing financial institutions to better assess the creditworthiness of such firms. In addition, digital payments enable transactions beyond physical proximity, allowing firms to access a wider customer base and participate in a broader market. They also reduce risks associated with cash handling, such as theft, loss, and counterfeit currency, thereby improving the overall security of transactions. Over time, these effects may contribute to the gradual formalisation of informal enterprises by integrating them more closely into formal financial systems.

2.3 Production-Side Outcomes and Digital Payments

While a large body of literature has examined the consumer-side effects of digital payment adoption — including changes in spending behaviour, financial inclusion, and transaction convenience — evidence on the production side remains comparatively limited. Specifically, studies examining how digital payments affect firm-level outcomes such as sales, output, revenue, and productivity are far fewer. Studies focusing on informal enterprises in India are rarer still.

The most directly relevant work for the Indian context is Dutta, Kar and Guha (2023),¹⁰ who use microdata from the World Bank's Informal Enterprise Surveys to empirically test whether adoption of digital payment instruments is associated with better firm performance, proxied by firm sales. Using matching models to address sample selection bias, they find that participation in digital platforms is associated with higher sales for informal firms — and crucially, this result holds both for firms that had been using digital technology before the COVID-19 outbreak and for those that adopted it only during the pandemic. To our knowledge, this is the first empirical study to examine production-side outcomes specifically for informal firms in India using this dataset.

At the firm level more broadly, Patnam and Yao (2020)¹¹ provide quasi-experimental evidence from India using granular transaction data from Paytm, one of India's largest mobile payment providers. Exploiting the 2016 demonetization shock as a source of variation in digital payment adoption, they find that firms adopting mobile payments increased sales after 6 months of use relative to non-adopting firms. They also find that mobile payment adoption is associated with lower subjective uncertainty about future sales and greater sales expectations among firm owners, suggesting that the benefits of digital payments may extend past immediate revenue effects toward broader improvements in business confidence and planning.

For slightly larger firms, Verma, Das, and Misra (2024)¹² examine the relationship between digital finance and MSME performance in India using the 2022 World Bank Enterprise Survey, which covers over 9,000 firms. They find a significant positive association between digital financial adoption and sales growth, though the effect on labour productivity is weaker and less consistent. This distinction — between effects on sales and effects on measured productivity — matters for the present paper, which uses both receipts per establishment and GVA per worker as separate outcome variables.

Taken together, this body of evidence suggests that digital payments do have meaningful effects on production-side firm outcomes, particularly sales and revenue. However, most existing studies rely on samples geographically restricted to particular cities or regions, making it difficult

to draw broad conclusions about the relationship at the state level. Moreover, the informal sector, which accounts for a disproportionate share of India's economic activity and employment, remains understudied relative to formal or registered firms. Therefore, this study addresses the aforementioned gap by constructing a state-level dataset, as shown in the following section.

3. Data and Methodology

To examine the relationship between digital payment penetration and informal sector performance across Indian states, I constructed a cross-sectional dataset covering 37 Indian states and union territories. The dataset combines information on digital payment intensity, informal enterprise performance, and macroeconomic controls, drawing entirely on secondary sources from official government agencies.

The analysis uses four dependent variables, all derived from the Annual Survey of Unincorporated Sector Enterprises (ASUSE) 2021–22,¹³ conducted by the National Sample Survey Office under the Ministry of Statistics and Programme Implementation (MoSPI). These are GVA per establishment, receipts per establishment, GVA per worker, and receipts per worker. The per-establishment measures capture scale effects — whether firms are earning more on average. Receipts per establishment capture whether digital payments are driving higher sales by enabling more frequent transactions, reaching a wider customer base, or reducing friction at the point of sale. GVA per establishment goes a step further and captures whether firms are also adding more value — that is, whether the increase in activity is translating into genuine economic contribution and not just higher turnover. The per-worker measures capture productivity effects — whether workers are contributing more to output. Together, they allow the analysis to identify which channel digital payments operate through — whether the effect is primarily about scaling up firm activity, improving worker productivity, or both.

Table 2A: Summary Statistics — Dependent Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
GVA per Establishment (₹, 2021-22)	37	282,971.7	120,675.1	136,228	582,212.5
Receipts per Establishment (₹, 2021-22)	37	1,121,834	680,831.7	532,444.1	4,089,608

Variable	Obs	Mean	Std. Dev.	Min	Max
GVA per Worker (₹, 2021-22)	37	11,800,000	7,827,652	1,165,398	27,100,000
Receipts per Worker (₹, 2021-22)	37	49,100,000	38,600,000	3,068,838	180,000,000

Source: Annual Survey of Unincorporated Sector Enterprises (ASUSE) 2021-22, MoSPI, Government of India.

Table 2A presents summary statistics for the four dependent variables. On average, informal establishments across Indian states recorded a GVA of ₹2,82,972 per establishment, with considerable variation ($SD = ₹1,20,675$), reflecting the structural diversity of India's informal sector. Receipts per establishment averaged ₹11,21,834, suggesting that revenue scales vary significantly across states. The per-worker measures show similarly wide dispersion, indicating that labour productivity in the informal sector differs substantially across states.

The main explanatory variable is total digital payment transactions in 2020–21, covering BHIM, IMPS, RuPay on POS, UPI, and USSD. Data was sourced from MeitY and NPCI.¹⁴ Since UPI accounts for roughly 80–85 per cent of all retail digital transactions in India, this variable largely captures UPI-led digitalisation.

Table 2B: Summary Statistics — Independent Variables of Interest

Variable	Obs	Mean	Std. Dev.	Min	Max
Digital Payment Transactions (2020-21)	37	1,250,000,000	3,550,000,000	612,988	21,500,000,000
Year-on-Year Growth in Digital Payments (%)	37	85.39	30.68	24.61	174.6

Source: Ministry of Electronics and Information Technology (MeitY) / National Payments Corporation of India (NPCI), 2020-21.

Table 2B presents summary statistics for the two explanatory variables. Digital payment transactions varied enormously across states in 2020–21, with a mean of ₹1.25 billion and a standard deviation of ₹3.55 billion, reflecting significant differences in digital adoption intensity

across states. The year-on-year growth in digital payments captures the pace of adoption between 2019–20 and 2020–21, with states averaging 85.39 percent growth but ranging from as low as 24.61 percent to as high as 174.60 percent — again indicating wide variation across states. The large cross-state variation in both the level and growth of digital payments is what this paper exploits to identify the relationship between digital payment penetration and informal sector performance.

The analysis includes four control variables to account for structural differences across states that could independently affect both digital payment adoption and firm performance. GSDP per capita (MoSPI, 2020–21) controls for overall economic development. Urbanisation rate, derived from RGI projected population data for 2021,¹⁶ captures differences in infrastructure and technology adoption. Internet subscribers per 100 population (TRAI, Table 1.28, December 2021)¹⁵ controls for digital infrastructure availability. Scheduled Commercial Bank branches per lakh population (RBI, March 2021)^{17,18} controls for baseline financial access, since digital payments require a bank account (See Table 2C).

Table 2C: Summary Statistics — Control Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
GSDP per Capita (₹, 2020-21)	33	178,224	95,855.01	44,175	435,949
Urbanisation Rate (% , 2021)	37	44.14	24.47	10.27	99.7
Internet Subscribers per 100 Population (Dec 2021)	37	70.21	54.40	7.28	319.43
SCB Branches per Lakh Population (March 2021)	37	16.20	8.25	6.13	44.01

Sources: GSDP — MoSPI National Accounts Statistics; Urbanisation — Office of the Registrar General and Census Commissioner of India (2019); Internet — TRAI Yearly Performance Indicators 2021, Table 1.28; Banking — RBI Basic Statistical Returns 2021. Note: GSDP per capita has 33 observations due to missing data for Lakshadweep, Ladakh, Dadra & Nagar Haveli, and Daman & Diu.

4. Empirical Specification and Analysis

Model 1: Impact of Digital Payment Intensity on Sales of Informal Enterprises

To investigate the relationship between digital payment penetration and the sales performance of informal businesses across Indian states, I ran a series of cross-sectional OLS regressions. The main variable I looked at was total digital payment transactions in 2020-21. This basically captures how much digital payment activity was happening in each state, and since UPI makes up around 80-85 per cent of all digital transactions in India, it largely reflects UPI adoption. On the outcome side, I looked at two things: receipts per establishment, which tells us how much each informal business was earning on average, and receipts per worker, which tells us how much revenue each worker was generating. I used both because one captures whether businesses as a whole are doing better, while the other captures whether individual workers are becoming more productive.

The regression equation is specified as follows:

$$Y_i = \alpha + \beta \text{ Digital_Payments}_i + \gamma X_i + \varepsilon_i$$

Here, Y_i is either receipts per establishment or receipts per worker in state i ; $\text{Digital_Payments}_i$ is the total volume of digital payment transactions in 2020-21; X_i is a vector of control variables including GSDP per capita, urbanisation rate, internet subscribers per 100 population, and SCB branches per lakh population; and ε_i captures unobserved differences across states. I run both a simple OLS without controls and a multiple OLS with controls to check how robust the results are.

Table 3: Relationship between Digital Payment Transactions and Receipts of Informal Enterprises

		Receipts per Establishment OLS (without controls) (1)	Receipts per Establishment OLS (with controls) (2)	Receipts per Worker OLS (without controls) (3)	Receipts per Worker OLS (with controls) (4)
Digital Transactions	Payment	-0.0000294**	-0.0000218***	0.0008835	0.0006131
		(0.0000109)	(0.00000507)	(0.0014107)	(0.0013889)

	Receipts per Establishment OLS (without controls) (1)	Receipts per Establishment OLS (with controls) (2)	Receipts per Worker OLS (without controls) (3)	Receipts per Worker OLS (with controls) (4)
GSDP per Capita		-2.773888		-190.6386
		(2.668847)		(133.0669)
Urbanisation Rate		16,647.96**		1,032,871**
		(7,853.522)		(407,745)
Internet Subs per 100 Population		3,005.704**		86,290.19
		(1,156.043)		(118,968.1)
Branches per Lakh Population		45,501.14		1,150,378
		(30,954.8)		(1,652,487)
Constant	1,158,572***	40,095.82	48,000,000***	20,900,000
	(124,429.2)	(310,855)	(6,916,644)	(18,500,000)
Number of observations	37	33	37	33
R-squared	0.0235	0.6036	0.0066	0.2325

*Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.*

Table 3 presents the relationship between digital payment intensity and receipts of informal enterprises across Indian states. The dependent variables are average receipts per establishment

and receipts per worker. Column (1) and Column (2) report specifications without and with controls, while Columns (3) and (4) repeat the analysis using receipts per worker as the outcome.

The results reveal an interesting asymmetry between establishment-level and worker-level outcomes. Digital payment transactions are negatively associated with receipts per establishment in both specifications. The coefficient remains statistically significant after controlling for GSDP per capita, urbanisation, internet penetration, and banking density, suggesting that states with higher digital payment intensity tend to have lower average receipts per informal establishment. Although the magnitude of the coefficient declines slightly after controls are introduced, the negative association remains robust.

In contrast, digital payment intensity is not significantly associated with receipts per worker in either specification. The absence of any statistically significant relationship indicates that digital payment penetration is not systematically related to labour productivity, at least when productivity is measured in terms of receipts generated per worker.

Among the control variables, urbanisation emerges as the strongest and most consistent predictor of enterprise performance. More urbanised states exhibit significantly higher receipts per establishment and receipts per worker, highlighting the importance of broader structural characteristics of state economies. Internet penetration is also positively associated with receipts per establishment, while GSDP per capita and banking density are not statistically significant.

Taken together, these findings suggest that digital payment intensity is associated primarily with differences in average establishment performance rather than worker productivity. One possible explanation is that states with mature digital payment ecosystems also have a larger concentration of micro-enterprises operating in competitive markets, resulting in lower average receipts per establishment. Since receipts per worker remain unaffected, the negative relationship appears unlikely to reflect lower worker productivity. Instead, it is more consistent with differences in enterprise composition, market structure, or the scale of informal establishments across states.

While these results provide useful evidence on the association between digital payment intensity and enterprise performance, they do not present the complete picture. The level of digital payment transactions largely reflects the maturity and scale of a state's digital payments ecosystem and may therefore capture long-standing structural differences across states rather than the effects of recent digitalisation. Consequently, states with high transaction volumes are not necessarily those experiencing the fastest expansion in digital payments. To distinguish between the effects of the existing level of digital payment adoption and the pace at which digital adoption is expanding, the next model replaces the level of digital payment transactions with

their year-on-year growth rate. This allows us to examine whether recent improvements in digital payment adoption are associated differently with the performance of informal enterprises.

Model 2: Impact of Growth in Digital Payments on Sales of Informal Enterprises

In this model, I switched from looking at the level of digital payment transactions to looking at their year-on-year growth rate. The reason for doing this is that I wanted to see if states that were growing faster in digital payment adoption also had better sales outcomes — which is a slightly different question from just asking how much total digital payment activity there was. The dependent variables remain the same as in Model 1 — receipts per establishment and receipts per worker.

The regression equation is specified as follows:

$$Y_i = \alpha + \beta \text{ Growth_Rate}_i + \gamma X_i + \varepsilon_i$$

Here, Y_i is either receipts per establishment or receipts per worker in state i ; Growth_Rate_i is the total year-on-year growth rate of digital payments from 2020 to 2021; X_i is a vector of control variables including GSDP per capita, urbanisation rate, internet subscribers per 100 population, and SCB branches per lakh population; and ε_i captures unobserved differences across states.

Table 4: Relationship between Growth in Digital Payments and Receipts of Informal Enterprises

	Receipts per Establishment OLS (without controls) (1)	Receipts per Establishment OLS (with controls) (2)	Receipts per Worker OLS (without controls) (3)	Receipts per Worker OLS (with controls) (4)
Growth Year on Year	-2,685.365 (2,639.797)	-1,732.092 (1,712.48)	-455,724.7*** (163,652.2)	-636,476.3*** (77,941.46)
GSDP per Capita		-2.880239 (2.793188)		-227.343* (125.2355)
Urbanisation Rate		16,409.89**		938,349.1**

	Receipts per Establishment OLS (without controls) (1)	Receipts per Establishment OLS (with controls) (2)	Receipts per Worker OLS (without controls) (3)	Receipts per Worker OLS (with controls) (4)
		(7,856.872)		(371,346.3)
Internet Subs per 100 Population		2,978.853***		132,071.2
		(1,202.45)		(80,959.42)
Branches per Lakh Population		47,197.61		1,362,851
		(31,110.19)		(1,472,133)
Constant	1,351,131***	165,969.5	88,000,000***	81,500,000***
	(311,646.6)	(319,026.9)	(17,800,000)	(16,100,000)
Number of observations	37	33	37	33
R-squared	0.0146	0.5939	0.1309	0.4595

*Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.*

Unlike Model 1, growth in digital payments does not exhibit a statistically significant relationship with receipts per establishment in either specification. Although the estimated coefficients remain negative, they are not distinguishable from zero once sampling variability is taken into account.

The results differ considerably for receipts per worker. The growth rate of digital payments is negatively associated with receipts per worker in both specifications, and the relationship remains statistically significant even after controlling for state characteristics. The magnitude of the coefficient also increases after controls are included, suggesting that states experiencing faster digital payment growth tend to have lower average receipts per worker.

Urbanisation again remains positively associated with enterprise performance, while internet penetration contributes positively to receipts per establishment. The explanatory power of the model also improves substantially once controls are introduced.

The contrasting results between establishment- and worker-level outcomes suggest that rapid expansion in digital payment adoption is not accompanied by higher labour productivity. One possible interpretation is that states experiencing faster digitalisation are simultaneously witnessing the entry of new firms and workers into informal markets. Under such circumstances, average receipts per worker may decline even if overall economic activity expands. Another possibility is that rapid growth in digital payments is concentrated in relatively low-income states that are catching up in adoption, implying that high growth rates reflect convergence rather than higher productivity.

Model 3: Impact of Digital Payment Intensity on Value Added of Informal Enterprises

The third model extends the analysis by replacing receipts with gross value added (GVA) as the outcome variable. While receipts measure the total value of sales generated by enterprises, GVA measures the value created after accounting for intermediate inputs and therefore provides a more comprehensive indicator of economic performance. In particular, GVA per worker is commonly interpreted as a measure of labour productivity. As in Model 1, this specification examines whether the level of digital payment transactions is associated with enterprise performance, but now focuses on value added rather than sales. The dependent variables are GVA per establishment and GVA per worker.

The regression equation is specified as follows:

$$Y_i = \alpha + \beta \text{ Digital_Payments}_i + \gamma X_i + \varepsilon_i$$

where Y_i represents either GVA per establishment or GVA per worker in state i ; $\text{Digital_Payments}_i$ measures the total volume of digital payment transactions; X_i includes GSDP per capita, urbanisation rate, internet subscribers per 100 population, and SCB branches per lakh population; and ε_i captures unobserved differences across states.

Table 5: Relationship between Digital Payment Transactions and Gross Value Added of Informal Enterprises

	GVA per Establishment OLS (without controls) (1)	GVA per Establishment OLS (with controls) (2)	GVA per Worker OLS (without controls) (3)	GVA per Worker OLS (with controls) (4)
Digital Payment Transactions	- 0.00000638*** (0.00000195)	- 0.00000417*** (0.000000865)	0.0003394 (0.0003643)	0.0002664 (0.0003364)
GSDP per Capita		-0.0901484 (0.192346)		-8.552732 (26.74689)
Urbanisation Rate		3,208.573*** (762.4426)		176,834.7** (67,343.68)
Internet Subs per 100 Population		96.81138 (162.9777)		2,419.237 (23,786.68)
Branches per Lakh Population		4,605.279** (2,076.843)		-78,457.84 (265,732)
Constant	290,956.7*** (21,627.13)	86,186.69*** (24,652.2)	11,400,000*** (1,346,454)	7,781,409*** (2,785,486)

		GVA per Establishment OLS (without controls) (1)	GVA per Establishment OLS (with controls) (2)	GVA per Worker OLS (without controls) (3)	GVA per Worker OLS (with controls) (4)
Number observations	of 37	33	37	33	
R-squared		0.0353	0.7152	0.0237	0.1745

*Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.*

The results closely mirror those obtained for receipts. Digital payment intensity is negatively associated with GVA per establishment in both specifications, and the relationship remains statistically significant after the inclusion of controls. Although the coefficient becomes smaller after controlling for state characteristics, it continues to indicate a negative association between digital payment intensity and average value added per establishment.

In contrast, digital payment intensity has no statistically significant relationship with GVA per worker. Thus, while states with greater digital payment activity tend to exhibit lower average GVA per establishment, there is no evidence that workers in those states are systematically less productive.

Urbanisation once again emerges as the strongest predictor of enterprise performance, exhibiting a positive and highly significant association with both establishment-level and worker-level GVA. Banking density also shows a positive association with GVA per establishment, whereas internet penetration and GSDP per capita are not statistically significant.

The consistency of the findings across receipts and GVA strengthens the interpretation that digital payment intensity is capturing structural differences across informal sectors rather than directly influencing productivity. If digital payments were reducing enterprise efficiency, one would expect both establishment-level and worker-level outcomes to decline. Instead, only the establishment averages exhibit a significant relationship, suggesting that the observed association is more likely driven by differences in enterprise composition, firm size, or competitive conditions.

Model 4: Impact of Growth in Digital Payments on Value Added of Informal Enterprises

The final model combines the two previous extensions by examining whether the growth in digital payment adoption, rather than its absolute level, is associated with value added generated by informal enterprises. While Model 3 focuses on differences between states with high and low digital payment intensity, this model investigates whether states experiencing faster digitalisation also exhibit higher GVA. This distinction is important because recent growth in digital payments may capture the ongoing diffusion of digital technologies, whereas the level of digital payments primarily reflects the maturity of a state's digital payment ecosystem. The dependent variables are GVA per establishment and GVA per worker.

The regression equation is specified as follows:

$$Y_i = \alpha + \beta \text{Growth_Rate}_i + \gamma X_i + \varepsilon_i$$

where Y_i denotes either GVA per establishment or GVA per worker in state i ; Growth_Rate_i is the year-on-year growth rate of digital payment transactions from 2020 to 2021; X_i is the vector of control variables comprising GSDP per capita, urbanisation rate, internet subscribers per 100 population, and SCB branches per lakh population; and ε_i captures unobserved state-level characteristics affecting enterprise performance.

Table 6: Relationship between Growth in Digital Payments and Gross Value Added of Informal Enterprises

			GVA per Establishment OLS (without controls) (1)	GVA per Establishment OLS (with controls) (2)	GVA per Worker OLS (without controls) (3)	GVA per Worker OLS (with controls) (4)
Growth Year	Year	on	232.2592	630.3931**	-94,337.59**	-136,055.5***
			(437.8673)	(274.6619)	(36,169.4)	(20,454.2)
GSDP per Capita				-0.0547741		-16.36155
				(0.1966886)		(20.07441)

	GVA per Establishment OLS (without controls) (1)	GVA per Establishment OLS (with controls) (2)	GVA per Worker OLS (without controls) (3)	GVA per Worker OLS (with controls) (4)
Urbanisation Rate		3,305.094***		156,519***
		(766.1492)		(49,613.99)
Internet Subs per 100 Population		28.52912		13,077.79
		(152.8359)		(16,190.52)
Branches per Lakh Population		4,564.22**		-39,479.42
		(1,818.333)		(212,496.6)
Constant	263,139.6***	20,303.06	19,900,000***	21,000,000***
	(48,719.79)	(35,818.93)	(3,823,016)	(3,085,184)
Number of observations	37	33	37	33
R-squared	0.0035	0.7233	0.1367	0.4225

*Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.*

Compared with the previous models, the results present the most nuanced picture. Without controls, growth in digital payments is positively associated with GVA per establishment, although the relationship is not statistically significant. After controlling for differences in GSDP per capita, urbanisation, internet penetration, and banking infrastructure, however, the coefficient becomes positive and statistically significant. This suggests that states experiencing faster growth in digital payment adoption also tend to exhibit higher average value added per informal

establishment, after accounting for other structural differences across states. Unlike the results obtained for digital payment intensity, where higher transaction levels were associated with lower average GVA per establishment, the growth specification indicates that recent expansion in digital payment adoption is associated with improved establishment-level performance.

The results for GVA per worker, however, point in a different direction. Growth in digital payments is negatively associated with GVA per worker in both specifications, with the relationship remaining statistically significant after the inclusion of controls. Thus, while states with faster digital payment growth tend to exhibit higher average value added per establishment, they also tend to record lower average value added per worker.

At first glance, these findings may appear contradictory. However, the two outcome variables measure different aspects of enterprise performance. GVA per establishment reflects the average value added generated by an enterprise, whereas GVA per worker measures the average value added generated by each worker. An increase in GVA per establishment therefore does not necessarily imply a corresponding increase in GVA per worker. Mathematically, GVA per worker depends not only on the value added generated by each establishment but also on the average number of workers employed within establishments. Consequently, it is possible for establishment-level value added to increase while value added per worker remains unchanged or even declines if employment expands proportionately faster than value added. Although the present analysis does not contain information on changes in average employment per establishment and therefore cannot identify the precise mechanism, the results demonstrate that enterprise-level performance and worker-level productivity need not move together.

Another important consideration is that the growth variable captures something fundamentally different from the level of digital payment transactions used in the earlier models. The level of digital payments reflects the maturity and scale of a state's digital payments ecosystem, whereas the growth rate reflects the pace at which digital adoption is expanding. Mature digital payment markets typically experience slower growth because a large share of transactions has already shifted to digital modes, while states with relatively lower initial adoption often record much faster growth as digital payments diffuse rapidly. Consequently, the level and growth variables should not be expected to produce identical results, as they capture different dimensions of digitalisation.

Urbanisation once again emerges as the most consistent determinant of enterprise performance, exhibiting a positive and statistically significant association with both measures of GVA. This finding is consistent across all four empirical models and highlights the importance of broader structural characteristics—such as market size, infrastructure, and agglomeration effects—in shaping the performance of informal enterprises. By comparison, internet penetration and

banking density exhibit weaker and less consistent relationships once other state characteristics are taken into account.

5. Conclusion

This study examined whether the rapid expansion of UPI and digital payment adoption has translated into improved production-side outcomes among India's informal enterprises. Using state-level cross-sectional regressions, the analysis investigated the relationship between digital payment intensity, digital payment growth, and four measures of enterprise performance: receipts per establishment, receipts per worker, GVA per establishment, and GVA per worker.

The empirical evidence suggests that the relationship between digital payments and production-side outcomes is more nuanced than commonly assumed. Higher levels of digital payment activity are associated with lower average receipts and GVA per establishment but exhibit no statistically significant relationship with receipts or GVA per worker. Conversely, faster growth in digital payment adoption is positively associated with GVA per establishment but negatively associated with both receipts per worker and GVA per worker, while exhibiting no statistically significant relationship with receipts per establishment.

Taken together, these findings indicate that digital payment adoption is not consistently associated with improved production-side outcomes across informal enterprises. If digital payments directly enhanced enterprise productivity, improvements would be expected across both establishment-level and worker-level indicators. Instead, the estimated relationships differ depending on the outcome measure considered, suggesting that the relationship between digital payments and enterprise performance is considerably more complex than a simple productivity-enhancing effect.

An important finding of the study is that the level and growth of digital payment adoption capture different dimensions of digitalisation. The level of digital payment transactions reflects the maturity and scale of a state's digital payment ecosystem, whereas the growth rate captures the pace at which digital adoption is expanding. Consequently, these measures answer different empirical questions and need not exhibit similar relationships with enterprise outcomes. Mature digital payment ecosystems generally experience slower growth because digital transactions are already widespread, while states with relatively low initial adoption often record higher growth as digital payments diffuse more rapidly. The contrasting results obtained across the four models therefore reflect these different dimensions of digitalisation rather than inconsistencies in the empirical analysis.

The findings also suggest that digital payments should be viewed primarily as an enabling technology rather than a direct determinant of enterprise productivity. Existing literature

highlights that digital payment systems reduce transaction costs, improve payment convenience, facilitate faster settlements, and expand access to customers. While these channels may improve the transactional environment in which enterprises operate, the present analysis does not find consistent evidence that such transactional improvements automatically translate into higher production-side outcomes. In other words, improvements in the payments ecosystem alone may not be sufficient to generate sustained improvements in receipts, value added, or labour productivity without complementary improvements in enterprise capabilities, technology adoption, market access, access to finance, infrastructure, and the broader business environment.

Accordingly, the principal contribution of this study is to show that the rapid diffusion of UPI and digital payments should not automatically be interpreted as evidence of improved production-side performance among informal enterprises. While digital payments have undoubtedly transformed the way businesses conduct transactions, their relationship with production outcomes appears to be considerably more nuanced. The findings indicate that digital payments are closely associated with the broader economic and institutional environment in which enterprises operate and should therefore be viewed as one component of enterprise development rather than an independent engine of productivity growth.

Finally, the findings should be interpreted in light of certain limitations. The empirical analysis is based on a relatively small cross-sectional sample comprising 37 States and Union Territories, limiting the statistical power of the econometric analysis and the precision of the estimated coefficients. Although robust standard errors are employed, the limited sample size warrants caution when interpreting statistically marginal relationships.

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