

EAC-PM Working Paper Series
EAC-PM/WP/51/2026

**Formalization of Labour Market in
India: Evidence from PLFS and ASUSE 2025
Unit-Level Data**



June 2026

Soumya Kanti Ghosh

Shagishna K

Falguni Sinha

Formalization of Labour Market in India: Evidence from PLFS and ASUSE 2025 Unit-Level Data

Soumya Kanti Ghosh, Shagishna K and Falguni Sinha¹

Abstract

This paper presents an integrated empirical analysis of India's labour market and unincorporated enterprise sector using unit-level microdata from two national surveys: the Periodic Labour Force Survey (PLFS) 2025 and the Annual Survey of Unincorporated Sector Enterprises (ASUSE) 2025. Both surveys cover the calendar year January-December 2025 and mark a significant methodological advancement in India's official statistical system. Drawing on the PLFS unit-level data, we examine the structural determinants of labour market informality, the role of training in reducing informal employment, and how educational attainment, female headship, and social background shape women's employment outcomes. We then bridge the worker-side evidence to the enterprise side using ASUSE 2025, analysing how digital adoption (ICT), enterprise registration, and government-linked formalization pathways has shaped labour productivity, formal credit access, and broader business outcomes in the unincorporated non-agricultural sector. Key findings include: (i) informality is structurally embedded, with education being the single most powerful individual-level deterrent to informal employment with graduates and above 43.8 percentage points less likely to be employed informally ; (ii) training exerts a meaningful negative effect with trained person in vocational training and skill development 4.8 percentage points less likely to be employed in the informal sector; (iii) female household headship significantly improves employment quality by raising the likelihood of regular wage work and reducing dependence on casual labour. SC and ST women though remain concentrated in casual labour are witnessing a gradual jump in formal employment; (iv) Digital adoption is a strong and robust driver of enterprise performance of micro and small enterprises with one-unit increase in the normalized ICT adoption index is associated with a 76% increase in labour productivity and 83% likelihood of enterprise registration; (v) enterprise registration is a significant enabler of formal credit access, with the effect holding consistently across manufacturing, trade, and strongest in other services; (vi) enterprises registered under government-linked Udyam or Udyam Assist access approximately 42% larger formal loans than comparable registered enterprises, with average loan amounts increasing from around Rs 3 lakh for unregistered enterprises to Rs 5.5 lakh for registered enterprises and nearly Rs 10 lakh for Udyam-linked enterprises; (vii) among female proprietors, registered enterprises have a 5.6 percentage-point higher probability of accessing formal credit compared to otherwise similar unregistered enterprises. Together, these findings offer a unified diagnostic of India's labour market and informal enterprise ecosystem, with direct implications for policy on formalization, skilling, digital inclusion, targeted credit delivery, and gender-responsive enterprise development.

Keywords: *Labour Force Participation, Informality, Employment Quality, ICT Adoption, Formalization, PLFS 2025, ASUSE 2025*

JEL: J21, J46, J81, 017, 033

¹ Soumya Kanti Ghosh is a part time member at PMEAC and Group Chief Economic Advisor, State Bank of India. Shagishna K and Falguni Sinha are economists at Economic Research Department, State Bank of India.

1. Introduction

India's labour market and its large informal enterprise sector present two interlinked development challenges. On the labour side, the persistence of informal employment, low female labour force participation, minimum wage non-compliance, and an expanding youth workforce have been central concerns in India's employment discourse (World Bank, 2016; La Porta and Shleifer, 2014). On the enterprise side, the unincorporated sector comprising household-owned and individually operated firms outside the Companies Act continues to account for a substantial share of employment and output, yet remains constrained by low productivity, limited access to institutional credit, and weak integration into formal regulatory and financial systems (NCEUS, 2009).

Recent policy interest has converged on two levers for addressing these challenges simultaneously: ICT adoption/digitalisation² and enterprise formalization. ICT adoption has been identified as a potential productivity-enhancing mechanism for micro and small enterprises, while government-sponsored registration programmes such as Udyam and Udyam Assist have been introduced with the explicit aim of extending formal credit access to previously excluded firms. Understanding whether and to what degree these two pathways deliver on their intended objectives requires rigorous empirical analysis using representative data.

This paper contributes to this agenda through an integrated analysis of two landmark national surveys: the Periodic Labour Force Survey (PLFS) 2025 and the Annual Survey of Unincorporated Sector Enterprises (ASUSE) 2025. Both surveys underwent significant methodological revisions in 2025 and cover a common reference period from January to December 2025, enabling a coherent joint analysis. While PLFS and ASUSE survey different units (individuals and households versus unincorporated enterprises), they are conceptually complementary. PLFS documents the conditions under which workers participate in the labour market, including the prevalence and determinants of informality, and ASUSE documents the enterprise structures within which many of those workers are employed, including their digitalization and formalization status. PLFS covers workers across all sectors of the economy, including agriculture, manufacturing, trade, and services, and is therefore used to analyse employment characteristics and labour market informality at the individual level. In contrast, ASUSE focuses on unincorporated enterprises operating in the non-agricultural sector, covering manufacturing, trade, and other service activities. Consequently, while PLFS captures

² The terms ICT and digitalization are used interchangeably throughout this paper

informal employment throughout the economy, including agriculture, ASUSE provides detailed information on the structure, performance, and characteristics of non-agricultural informal enterprises. Taken together, the two surveys provide a worker-enterprise view of India's informal economy.

Beyond labour force participation, the nature and quality of employment are critical dimensions of labour market outcomes. Accordingly, the analysis proceeds along two dimensions. First, we examine the determinants of labour market informality, with a particular focus on the role of skill development and training in reducing the likelihood of workers being employed in informal jobs. Second, we analyse the quality composition of women's employment by distinguishing between self-employment, regular wage employment, and casual labour. In doing so, we assess how factors such as educational attainment, training, female household headship, and social background influence women's employment outcomes and their access to more stable forms of work. Together, these analyses provide a comprehensive understanding of the factors shaping both the formality and quality of employment in the labour market.

Following are the specific research questions of the study. First, what are the structural determinants of informality and employment quality in India's labour market as revealed by PLFS 2025? Second, does ICT adoption significantly improve the registration and labour productivity among unincorporated enterprises, and does this effect vary by location and sector? Third, does enterprise registration through government-linked formalization programmes improve access to formal credit, and by how much?

The paper is organized as follows. Section 2 reviews the relevant literature on informality in the workforce followed by formalization-credit nexus and ICT adoption and labour productivity. Section 3 describes the data and methodology. Section 4 presents descriptive analysis. Section 5 reports empirical findings from both PLFS and ASUSE. Section 6 provides the summary, conclusion, and policy recommendations of the study.

2. Related Literature

2.1. Informality in workforce

Informality remains a dominant feature of labour markets in developing economies, accounting for a substantial share of total employment. The International Labour Organization (ILO) defines informal employment as remunerative work that is not registered, regulated, or protected under existing legal and regulatory frameworks, including both self-employment and

wage employment arrangements. Informal workers typically lack written contracts, social security coverage, employment benefits, and legal protection (Chen, 2012).

Early studies viewed informality as a residual sector that absorbed surplus labour excluded from the formal economy (Williams & Lansky, 2013). However, subsequent research has demonstrated that informality is a heterogeneous phenomenon encompassing self-employed workers, unpaid family workers, casual labourers, and workers employed informally within formal enterprises. This broader perspective recognizes that informality exists not only outside but also within the formal sector.

The literature identifies multiple drivers of workforce informality. Poverty, low educational attainment, limited access to productive assets, migration, and weak institutional capacity often push workers into informal employment. At the same time, firms may choose informal arrangements to avoid regulatory compliance costs, taxation, and labour regulations. Consequently, informality reflects both exclusion from formal opportunities and voluntary responses to institutional constraints.

A large body of empirical evidence associates informality with lower productivity, reduced earnings, and limited access to social protection. Informal workers are more vulnerable to income shocks, occupational hazards, and employment insecurity than their formal counterparts (Shekar & Mansoor, 2020). Informality is also linked to inequality as workers in the informal economy generally receive lower wages and have fewer opportunities for skill development and upward mobility.

In the Indian context, informality continues to characterize a large proportion of employment despite economic growth and structural transformation (Shembavnekar, 2019). Studies suggest that labour market reforms and economic liberalization have not necessarily reduced informality; rather, informal employment has expanded within both formal and informal enterprises. The persistence of informality reflects the interaction of labour market institutions, enterprise characteristics, and workforce vulnerabilities.

Literature highlights the role of education, skills development, financial inclusion, and digitalization in facilitating transitions from informal to formal employment. Improved human capital, access to formal financial services, and the adoption of digital technologies can enhance productivity, strengthen enterprise growth, and promote formalization, thereby improving the quality of employment and workers' welfare (Shekar & Vidyarani, 202; Srivastava, 2022; Bahl & Sharma, 2023; Ray, 2024).

Empirical analysis of PLFS data consistently finds that agricultural employment, casual employment, and female employment are strongly associated with informal work arrangements, while higher education and urban location reduce informality probability (La Porta & Shleifer, 2014).

The 2025 PLFS round introduced a shift to a calendar-year reference period and a substantially expanded sample, offering an opportunity to revisit these structural patterns with greater statistical precision and improved geographic disaggregation. This paper uses PLFS 2025 to provide an updated empirical account of employment quality and informality determinants, forming the labour-market foundation on which the enterprise-side analysis from ASUSE is built.

2.2. Formalisation and Credit Access

Access to finance remains one of the most significant constraints faced by micro, small, and informal enterprises in developing economies. A large body of literature argues that enterprise formalisation can alleviate financing constraints by improving transparency, legal recognition, and information availability, thereby enhancing firms' ability to access institutional credit (Truong & Bui, 2022). Formalisation enables enterprises to establish a verifiable business identity and generate documented records that financial institutions can use to assess creditworthiness (La Porta & Shleifer, 2014).

According to the institutional economics perspective, informal enterprises often face difficulties in obtaining formal credit because they operate outside regulatory frameworks and lack legally recognized documentation (La Porta & Shleifer, 2014). As a result, lenders encounter significant information asymmetries and perceive informal enterprises as riskier borrowers (Beck et al., 2005). Registration and formalisation help reduce these information gaps by providing proof of business existence, ownership, and operational activities, thereby lowering transaction and monitoring costs for financial institutions (Stiglitz & Weiss, 1981).

Empirical evidence suggests that formal enterprises are more likely to obtain bank financing than informal firms. Using firm-level data from multiple developing countries, Beck et al. (2005) found that financing obstacles are significantly more severe for smaller and informal enterprises. Similarly, Ayyagari et al. (2010) showed that formal firms enjoy better access to external finance due to their greater visibility and compliance with regulatory requirements.

Research focusing on enterprise registration reforms further demonstrates the benefits of formalisation for financial inclusion. Fajnzylber et al. (2011), studying the impact of simplified

business registration in Brazil, found that formalisation increased firms' likelihood of operating through formal channels and improved access to financial services. Formal registration enables firms to establish financial histories and engage more effectively with banks and government-supported lending programmes.

In the Indian context, enterprise registration initiatives at a large scale such as the Udyog Aadhaar Memorandum (UAM) and the Udyam Registration Portal have been introduced to encourage formalisation among micro and small enterprises. Formal registration enhances the visibility of enterprises within the formal financial ecosystem and facilitates access to priority sector lending, government credit guarantee schemes, and other institutional support mechanisms (Reserve Bank of India, 2023). Recent studies indicate that registered enterprises are more likely to obtain institutional credit and receive larger loan amounts than unregistered enterprises, highlighting the role of formalisation in reducing credit constraints (Berger & Udell, 2006).

Theoretical explanations for this relationship are grounded in information asymmetry theory (Stiglitz & Weiss, 1981). Financial institutions face challenges in assessing borrower quality when reliable information is unavailable. Formalisation addresses this problem by generating verifiable records and improving transparency, thereby reducing adverse selection and moral hazard concerns. Consequently, registered enterprises are more likely to satisfy lenders' screening requirements and gain access to formal credit markets.

2.3. ICT Adoption and Labour Productivity

India's digitalisation journey reflects a structural transformation from limited digital access to a population-scale Digital Public Infrastructure ecosystem, where identity, connectivity, payments and welfare delivery now operate through integrated public digital rails. The expansion of digital connectivity created the foundation for this change, with internet connections increasing from 25.15 crore in March 2014 to 96.96 crore in June 2024, broadband connections rising from 6.1 crore in March 2014 to 94.92 crore in August 2024, and average monthly wireless data consumption increasing 353 times, from 61.66 MB in March 2014 to 21.30 GB in June 2024. On this foundation, UPI has transformed everyday transactions from cash-based exchanges to real-time digital payments: monthly UPI transactions rose from only 1.99 million in December 2016 to 16,730.01 million in December 2024, while transaction value increased from Rs 707.93 crore to Rs 23,24,699.91 crore during the same period; by January 2026, UPI had further scaled to 21.70 billion transactions worth over Rs 28.33 lakh crore, with 691 banks live on the platform. The same digital architecture has reshaped welfare delivery

through DBT and PFMS, enabling benefits to move directly into citizens' bank accounts, reducing intermediaries, delays and leakages; PIB records that DBT transfers crossed Rs 49.09 lakh crore by January 2026, while the Government saved over Rs 4.31 lakh crore between 2015 and March 2024 by removing duplicate and fake beneficiaries. Citizen-facing platforms have also deepened this transformation: Aadhaar crossed 144 crore generated numbers by March 2026, with more than 2,707 crore authentication transactions in 2024-25, while DigiLocker reached 67.63 crore users and over 950 crore issued documents by March 2026, making verified digital identity and paperless service delivery part of everyday governance. Together, these indicators show that digitisation in India has moved beyond technology adoption to a governance transformation connecting citizens, markets and the State through faster payments, targeted welfare, verified identity and accessible digital services at national scale.

In this scenario the relationship between ICT adoption and labour productivity has been extensively examined in the productivity and digital transformation literature (Shekar & Vidyarani, 2025). ICT is viewed as a general-purpose technology that enhances the efficiency of production processes, facilitates information exchange, improves coordination among economic agents, and reduces operational costs. Through these channels, ICT enables firms to produce more output with the same quantity of labour, thereby increasing labour productivity (World Bank, 2016; Jorgenson & Stiroh, 2000).

Early studies on ICT and productivity were influenced by the "productivity paradox," which questioned why large investments in computers and information technologies were not immediately reflected in productivity statistics (Solow, 1987). Subsequent research, however, demonstrated that productivity gains from ICT emerge over time and are often contingent on complementary investments in human capital, organizational restructuring, and managerial practices (Brynjolfsson & Hitt, 1996; Pilat, 2005). Draca et.al (2006) conclude that the empirical evidence overwhelmingly supports a positive role of ICT in explaining productivity growth at both the firm and aggregate levels.

A comprehensive review by Kretschmer (2012) finds that most empirical studies report a positive and statistically significant relationship between ICT adoption and productivity. The review highlights that ICT contributes to productivity through automation of routine tasks, improved communication, better inventory management and enhanced access to information (Shekar & Vidyarani, 2025). Firm-level studies generally show stronger productivity effects than aggregate-level analyses because they better capture heterogeneity in technology adoption and utilization.

Using firm-level data from European countries, Gal et al. (2019) show that digital technology adoption is associated with significant productivity gains, particularly in manufacturing and routine-intensive sectors. The study also finds that productivity benefits are larger for firms possessing complementary capabilities such as skilled workers and organizational capital, suggesting that technology alone is insufficient to generate productivity improvements.

Evidence from developing economies similarly points toward substantial productivity gains from ICT adoption. A study of Indian manufacturing firms finds that ICT investments significantly enhance labour productivity, with the effects being particularly pronounced among small firms and firms operating in medium and high R&D intensive industries (Shekar & Joseph, 2022). The findings suggest that absorptive capacity plays a crucial role in translating ICT investments into productivity gains.

The emerging Industry 4.0 literature further supports the positive productivity effects of technology adoption. Firm-level evidence indicates that adoption of advanced digital technologies increases labour productivity by improving production efficiency, reducing downtime, and enabling better resource allocation (Shekar & Joseph, 2022). These benefits are especially important for micro, small, and medium enterprises (MSMEs), where technology adoption can help overcome scale constraints and improve competitiveness.

Giuri et.al (2006) analyse the interplay between ICT, skills, and organizational change in 540 Italian manufacturing firms from 1995 to 2000. Their study finds strong evidence supporting the complementarity between ICT and skilled labour (skill-biased technical change), but limited support for full organizational complementarity involving all three factors. Notably, the productivity gains from adopting ICT, skills, and organizational change vary by firm size; large firms benefit more from their joint adoption, while small and medium firms face constraints that reduce such complementarities. These results highlight the importance of considering firm size and organizational context when examining the productivity effects of technological and organizational innovations.

Zhu et al. (2021) provide a comprehensive review of the literature on the impact of ICT investments on firm productivity, particularly in the context of China. Building on foundational economic theories (Romer, 1989; Solow, 1957) that highlight technological advancement as the key driver of long-term productivity growth, the paper discuss empirical evidence demonstrating the important role of R&D in enhancing firm innovation and productivity (Griliches, 1979; Harhoff, 1998; Wu, 2006; Sun & Wang, 2014; Liu & Hou, 2014). They further review the evolving literature on ICT's role, acknowledging early doubts exemplified

by the “Solow Paradox” (Solow, 1987) which showed limited ICT impact on productivity but noting that more recent studies find ICT contributes to reducing transaction costs, improving organizational efficiency, and fostering innovation, thereby enhancing firm productivity (Black & Lynch, 2001; Bresnahan et al., 2002; Jorgenson, 2001; Wang et al., 2006; Li & Wu, 2008).

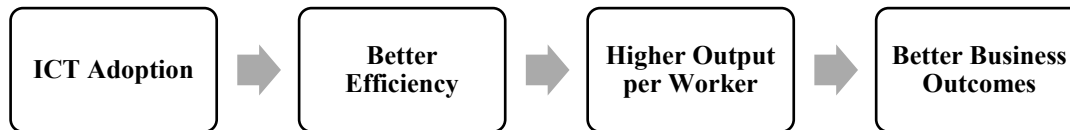
Nevertheless, the literature also cautions that ICT adoption does not automatically lead to productivity improvements. Some studies find relatively modest average effects and highlight substantial variation across firms. Productivity gains depend on factors such as workforce skills, organizational change, management quality, and the effective integration of digital technologies into business processes. This has led researchers to emphasize the complementarity between ICT, human capital, and institutional capabilities.

2.4. Conceptual Framework

The framework is informed by the productivity literature, particularly the work of Brynjolfsson and Hitt (1996, 2003), Jorgenson and Stiroh (2000), and Bloom et al. (2012), which emphasize efficiency gains and organizational improvements as the primary channels through which ICT enhances labour productivity.

Figure 1 presents the conceptual pathway linking ICT adoption to labour productivity. The adoption of digital technologies such as smartphones, internet connectivity, digital payment systems, and accounting or inventory management software improves operational efficiency by reducing errors, saving time, and facilitating coordination within the enterprise. Enhanced efficiency translates into higher output per worker through faster production processes and improved service delivery. Consequently, labour productivity, measured as output or gross value added per worker, increases. Higher productivity further contributes to improved business outcomes, including greater sales, profitability, and competitiveness. This framework is consistent with the view that ICT functions as a productivity-enhancing technology by enabling firms to utilize labour more effectively and efficiently.

Figure 1: Conceptual framework linking ICT adoption and labour productivity



Source: Author's creation

3. Data and Methodology

3.1. Data

Periodic Labour Force Survey (PLFS) 2025

The PLFS is a nationwide survey conducted by the National Statistical Office (NSO) under the Ministry of Statistics and Programme Implementation (MoSPI) to estimate key employment and unemployment indicators in India. Starting January 2025, the survey underwent substantial methodological revisions. The reference period shifted from the traditional July-June agricultural year to the calendar year (January-December), aligning India's labour force statistics with international reporting practices. The quarterly frequency of data collection was extended from urban-only to both rural and urban areas under the Current Weekly Status (CWS) framework (MoSPI, 2025a).

The sample size was also significantly expanded from an average of approximately 12,800 First Stage Units (FSUs) and 1.02 lakh households in earlier rounds to 22,594 FSUs, 2,70,472 households, and 11,48,634 persons surveyed in PLFS 2025. Of these, 8,91,266 persons were aged 15 years and above, forming the core working-age population for labour market analysis. Districts were treated as the basic strata, separately for rural and urban sectors, improving geographic representativeness.

For this analysis, we obtained the unit-level data from the MoSPI website in raw text format and converted them into structured datasets. Unique individual identifiers were constructed using a combination of FSU serial number, sub-sample ID, sector, NSC region/district code, stratum, sub-stratum, hamlet/sub-block number, household number, and person number. We then merged household and individual-level datasets were merged using these identifiers to create a unified micro dataset. State and district identifiers were appended to enable regional analysis, and survey weights were applied throughout.

Annual Survey of Unincorporated Sector Enterprises (ASUSE) 2025

The ASUSE is conducted by the National Sample Survey Office (NSSO) under MoSPI to collect detailed information on India's unincorporated non-agricultural enterprises those not

registered under the Companies Act and owned by an individual, household, or group of individuals. The survey covers enterprises engaged in manufacturing, trade, and other services, excluding agriculture. It includes both rural and urban areas across India (MoSPI, 2025b).

The ASUSE 2025 covered the period January to December 2025 using a stratified sampling design. The unit-level data were provided in text file format across 16 schedule blocks.

We constructed a common enterprise identifier from FSU number, segment number, second-stage stratum number, and sample establishment number, enabling block-level datasets to be merged into a consolidated enterprise-level database. The survey collects detailed information on enterprise characteristics, production, employment, ownership structure, digital technology usage, registration status, and access to finance. Sampling weights provided by the survey were used to ensure that the estimates are representative of the population of unincorporated enterprises in India.

3.2. Methodology

Log linear Regression

To examine the relationship between ICT adoption and labour productivity, the following Log-linear regression model is estimated.

$$\ln(Y_i) = \alpha + \theta R_i + \beta' X_i + \delta_{sector(i)} + \gamma_{State(i)} + \varepsilon_i \quad (1)$$

$\ln(Y_i)$ denotes the logarithm of labour productivity, R_i represents the ICT adoption index, and X_i is a vector of enterprise-level controls comprising firm age, capital intensity, ownership structure, enterprise size, and educational attainment of the proprietor. Sector, state, and district fixed effects are included to account for unobserved heterogeneity across industries and geographical locations. Robust standard errors are used to address potential heteroscedasticity.

To assess whether Udyam and Udyam Assist registrations are associated with higher levels of institutional credit beyond ordinary registration, we again estimated a log-linear regression model among registered enterprises reporting positive formal loan amounts. The dependent variable is the natural logarithm of the formal loan amount received by the enterprise. The key explanatory variable is an indicator equal to one if the enterprise is registered under either Udyam Registration or the Udyam Assist Platform and zero if it belongs to any other registration category. The specification additionally controls for enterprise location, enterprise size, owned fixed assets, and sector-specific characteristics.

To examine whether government-linked registration mechanisms are associated with stronger formalization practices, we constructed a Formalization Practice Score (FS) using three indicators of enterprise formalization: (i) ownership of a bank account in the name of the enterprise, (ii) maintenance of audited books of accounts, and (iii) engagement in online business activity. The resulting composite score was then normalized to range from 0 to 100, with higher values indicating a greater degree of formalized business practices. We then estimate the regression model using vector of enterprise-level controls including enterprise size and owned fixed assets, and δ_s and θ_k represent state and sector fixed effects, respectively.

Logit Model

To examine the relationship between ICT adoption and enterprise formalization, a binary logit model is estimated. Formalization is measured using a registration dummy that takes the value one if the enterprise is registered under any statutory authority and zero otherwise.

$$P(Y_i = 1 | X_i) = \frac{\exp(\alpha + \beta ICT Index_i + \gamma' Z_i)}{1 + \exp(\alpha + \beta ICT Index_i + \gamma' Z_i)} \quad (2)$$

$ICT Index_i$ denotes the ICT adoption index and Z_i represents a vector of enterprise-level characteristics and control variables. The coefficient β captures the association between ICT adoption and the likelihood of enterprise registration. Since logit coefficients are not directly interpretable in probability terms, average marginal effects are reported and discussed in the empirical analysis.

For the determinants of informal employment, we estimate a binary logistic regression model with informal employment status as the dependent variable. Following the operational definition of informal employment adopted in the literature and consistent with the National Commission for Enterprises in the Unorganised Sector (NCEUS), a worker is classified as informal if he or she lacks at least one of the following employment protections: (i) social security benefits, (ii) a written job contract, and (iii) entitlement to paid leave. Accordingly, an informal worker takes the value of one if any of these protections are absent and zero otherwise. This multidimensional definition captures the broader concept of employment vulnerability and labour market informality beyond the mere absence of social security coverage.

To examine the association between training and labour market informality, a logit model is estimated using unit-level PLFS data, where the dependent variable is a binary indicator equal to one if an individual is engaged in informal employment and zero otherwise. The key explanatory variable is a dummy indicating whether the individual has received training, with individuals who have not received any training constituting the reference category. The

specification controls for a range of demographic and socio-economic characteristics and includes state and district fixed effects to account for unobserved regional heterogeneity.

To identify the factors associated with the quality composition of women's employment, we estimate a multinomial logit model. The dependent variable is the employment status of women, classified into three categories i.e. self-employment, regular wage employment, and casual labour. The key explanatory variables include female household headship, educational attainment, and social group, while controlling for a range of individual and household characteristics. State and district fixed effects are included to account for unobserved regional heterogeneity.

Linear Probability Model: Enterprise registration and access to institutional credit

To examine the association between enterprise registration and access to formal credit, we estimate the following Linear Probability Model (LPM):

$$P(Credit_i = 1|X_i) = E(Credit_i|X_i) = \alpha + \beta Registration_i + \gamma'X_i + \delta_s + \theta_k + \varepsilon_i \quad (3)$$

where $Credit_i$ is a binary indicator equal to 1 if enterprise i has access to formal credit and 0 otherwise. $Registration_i$ is an indicator variable taking the value 1 if the enterprise is registered under any Act, local authority, licensing authority, or regulatory framework and 0 otherwise. X_i is the vector of enterprise-level controls including urban location, number of workers, and the logarithm of owned fixed assets. δ_s and θ_k denote state and sector fixed effects. To examine gender differences in access to formal credit, we estimate the following LPM with female owned enterprise dummy equal to one if the enterprise is owned by a female proprietor and zero if owned by a male proprietor. Male proprietors constitute the reference category. The estimated average marginal effects and predicted probabilities are used to assess how these characteristics influence the likelihood of women being employed in different forms of work, thereby providing insights into the determinants of employment quality among women.

4. Descriptive Analysis

4.1. Growth in Unincorporated Enterprises and Work Force

Figure 2 part 1 presents the number of unincorporated non-agricultural enterprises across rural and urban India based on successive rounds of ASUSE. The total number of establishments increased from 6.50 crore in 2022-23 to 7.34 crore in 2023-24 and further to 7.92 crore in 2025, indicating sustained expansion of the sector. The overall increase of nearly 22 per cent over the

period highlights the growing importance of unincorporated enterprises in India's economic structure.

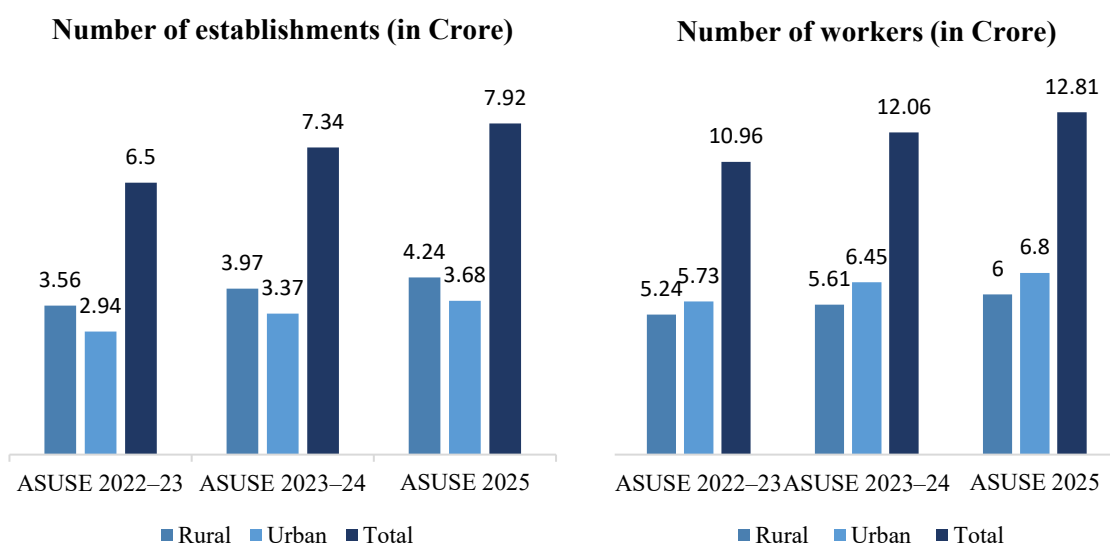
The growth is observed in both rural and urban areas. Rural establishments increased from 3.56 crore in 2022-23 to 4.24 crore in 2025, while urban establishments expanded from 2.94 crore to 3.68 crore during the same period. Although rural areas continue to account for the larger share of enterprises, the increase in urban establishments reflects the growing role of non-farm and service-oriented entrepreneurial activities in urban India (Naudé, 2018; Dana, 2022).

The continuous rise in the number of establishments suggests that the unincorporated sector remains an important source of livelihood generation and economic activity (NCEUS, 2009). Given the sector's expanding scale, improving its productivity and facilitating its transition towards formalization become critical policy objectives. This provides the motivation for examining whether ICT adoption can enhance labour productivity and encourage enterprise formalization in the subsequent empirical analysis.

Part 2 of the Figure 2 shows the number of workers across three rounds of ASUSE, the urban workforce consistently exceeded the rural workforce, indicating a greater concentration of employment in urban areas. Both rural and urban sectors exhibited a growth trend, suggesting an expansion in employment opportunities over time. The total number of workers also increased steadily from 2022-23 to the 2025 ASUSE round, reflecting overall growth in labour force participation within the unincorporated sector.

In percentage terms, the rural workforce increased by approximately 12.5% from 2022-23 to 2025 rounds, while the urban workforce grew by about 18.2%. The total workforce recorded an overall increase of roughly 16% during the same period. These results indicate sustained employment growth across both rural and urban areas, with urban regions showing a comparatively stronger rate of expansion.

Figure 2: Enterprise establishment and workers



Source: ASUSE 2022-23, 2023-24, & 2025

4.2. Contribution of the Unincorporated Sector to Gross Value Added

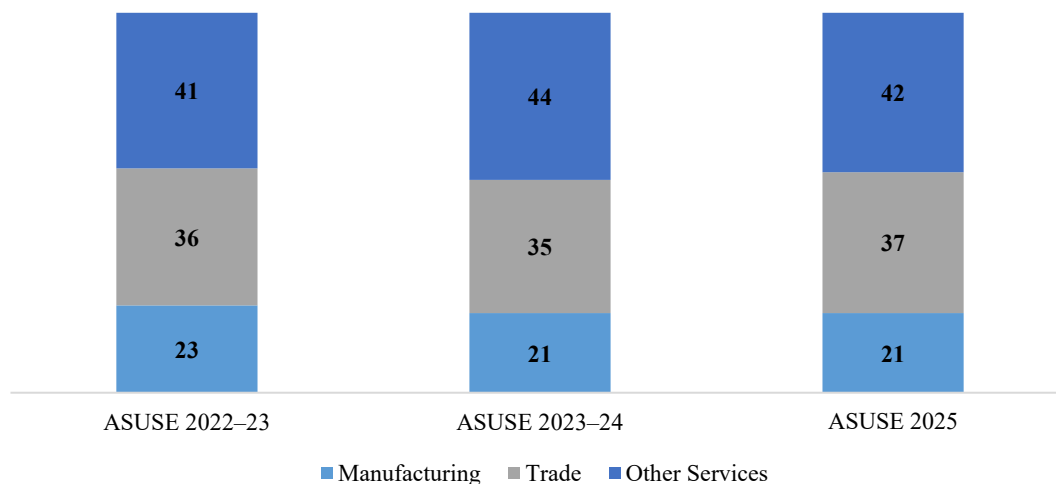
The unincorporated sector continues to play a significant role in India's economy, accounting for a notable share of Gross Value Added (GVA). The contribution of the sector to total GVA has shown a gradual increase in recent years, rising from 9.9% in 2022-23 to 10.8% in 2023-24, and further to 11.2% in 2025. This upward trend indicates the growing economic importance of unincorporated enterprises in generating output and employment. The increase may be attributed to the post-pandemic recovery of small businesses, expansion of service-oriented activities, and improved market participation of informal enterprises. The findings suggest that despite the increasing emphasis on formalization, unincorporated enterprises remain a critical contributor to economic activity, particularly in labour-intensive sectors.

The sectoral distribution of GVA generated by unincorporated enterprises reveals the dominant role of the services sector, followed by trade, while manufacturing accounts for the smallest share. As shown in Figure 3, services contributed 41% of total unincorporated sector GVA in 2022-23, increasing to 44% in 2023-24 before moderating slightly to 42% in 2025. The consistently large share of services reflects the growing importance of activities such as transportation, accommodation, communication, professional services, and other service-based enterprises within the unincorporated economy.

The trade sector accounted for 36% of GVA in 2022-23, declined marginally to 35% in 2023-24, and subsequently increased to 37% in 2025. The stable contribution of trade indicates the continued importance of retail and wholesale activities, which constitute a substantial segment of unincorporated enterprises across both rural and urban areas. In contrast, the manufacturing

sector contributed the lowest share of GVA, declining from 23% in 2022-23 to 21% in 2023-24, where it remained in 2025. The relatively lower and declining share of manufacturing suggests that output growth within the unincorporated sector has been increasingly driven by services rather than production-oriented activities. This trend is consistent with the broader structural transformation of the Indian economy towards service-led growth.

Figure 3: Share of GVA sector wise (%)



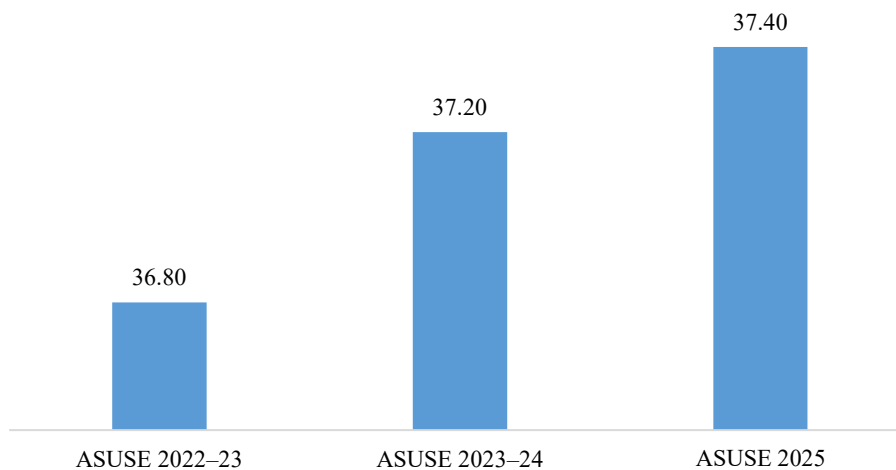
Source: ASUSE 2022-23, 2023-24, & 2025

4.3. Registration and Ownership of the Enterprises

Figure 4 shows the registration of unincorporated enterprises under statutory act/authority across multiple ASUSE rounds. Registration increased from 36.8% (2022-23) to 37.2% (2023-24), further reaching 37.5% in ASUSE 2025.

Figure 5 shows that women are emerging as enterprise leaders. The share of female-headed proprietary establishments increased steadily from 23% in 2022-23 to 26% in 2023-24, and further to 27% in 2025, indicating a gradual strengthening of women’s participation in enterprise ownership and management.

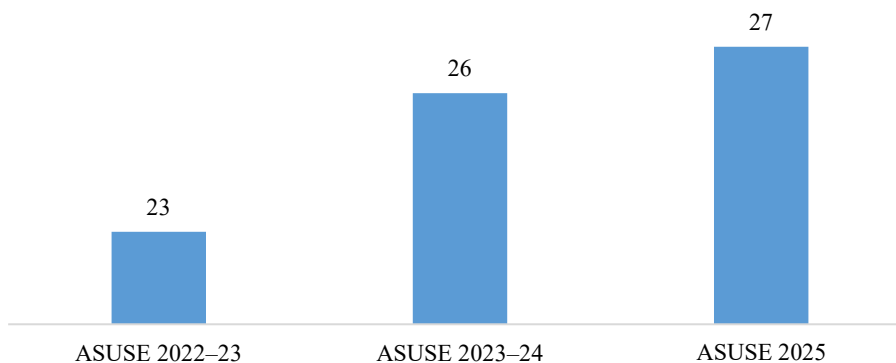
Figure 4: Enterprises registered under act/authority (%)



Source: ASUSE 2022-23, 2023-24, & 2025

The differences are even more pronounced when examining the scale of credit accessed. The average formal credit amount for registered female-owned enterprise Rs 5 lakh, compared to only about Rs 75,000 among unregistered female-owned enterprises. Thus, registration is associated not only with a higher likelihood of obtaining formal credit but also with substantially larger loan amounts.

Figure 5: Female headed proprietary establishments (%)

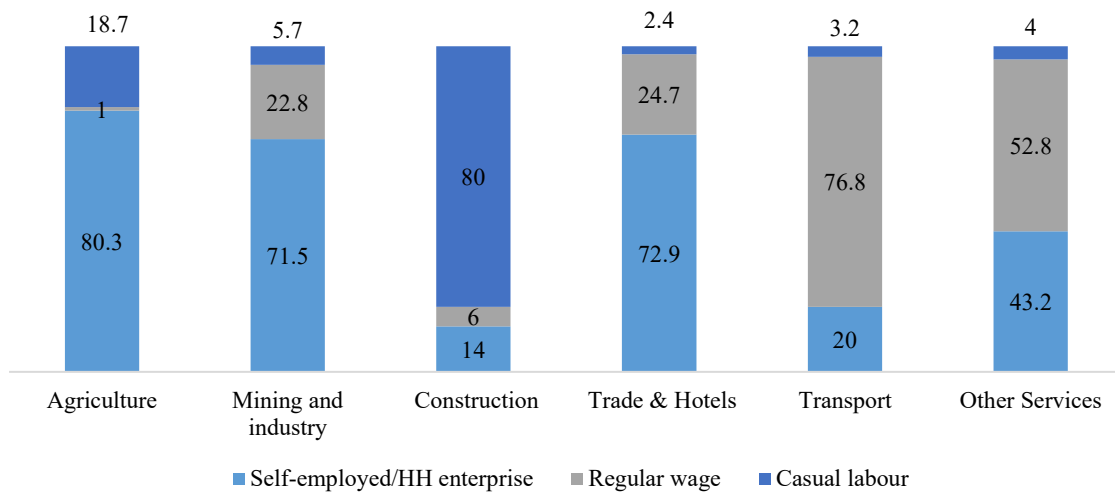


Source: ASUSE 2022-23, 2023-24, & 2025

4.4. Female Employment Quality by Industry Type

Figure 6 shows the quality of female employment by industry type. In agriculture, most of the workers are self-employed while construction sector is dominated by casual workers. Further, in transport, female employment under regular wage is the highest.

Figure 6: Female employment quality by industry type (%)



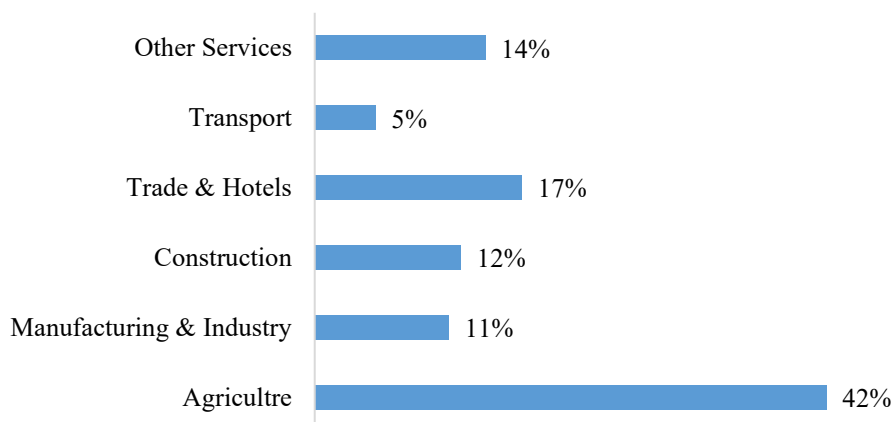
Source: PLFS, 2025

4.5. Industry-wise Concentration of Informal Workers- PLFS

The concentration of informal workers by industry type. Informal workers remain predominantly rural in nature, with nearly 59% concentration in the rural areas, while urban areas account for around 41% of the informal workforce.

Figure 7 depicts the industry composition of informal workers indicates that agriculture remains the largest source of informal employment, accounting for nearly 42% of the informal workforce, followed by trade and hotels (17%) and other service activities (14%).

Figure 7: Industry Composition (%)

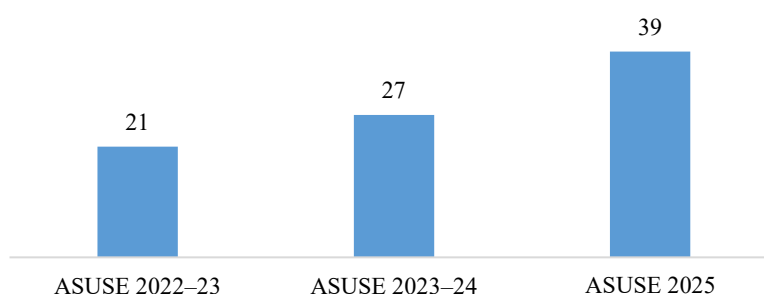


Source: PLFS, 2025

4.6. Trend in Establishments Using Internet (%)

The proportion of establishments using the internet has increased significantly through the ASUSE rounds, rising from 21% in 2022-23 to 27% in 2023-24 and further to 39% in 2025 (Figure 8). The overall increase of 18 percentage points over the period reflects the growing penetration of digital technologies among enterprises. The accelerated growth observed after 2023-24 suggests that businesses are increasingly incorporating internet-based technologies into their operations, facilitated by improvements in digital infrastructure and the expansion of the digital economy. The findings indicate a gradual shift towards greater digitalization among enterprises, although the persistence of a sizeable share of non-internet-using establishments points to the existence of digital disparities that require policy attention.

Figure 8: Establishment Using Internet (%)



Source: ASUSE 2022-23, 2023-24, & 2025

State-level estimates reveal substantial variation in internet usage among establishments across India. In 2025, the proportion of establishments using the internet was highest in Himachal Pradesh (68%), followed by Haryana (66%) and Rajasthan (59%). Maharashtra (58%), Punjab (52%), and Uttarakhand (50%) also recorded relatively high levels of internet usage, with above 50% of establishments reporting internet access. States such as Karnataka, Tamil Nadu, Gujarat, Chhattisgarh and Telangana exhibited moderate levels of internet penetration ranging between 49 and 43%. At the lower end of the distribution, Uttar Pradesh, West Bengal, Bihar recorded comparatively lower levels of internet usage among establishments. The all-India average increased from 21% in 2023 to 39% in 2025, indicating a rise in digital adoption among establishments across the country.

5. Empirical Results and Findings

5.1. Determinants of the Informality

Table 1 shows the determinants of the informal workers, female workers are 4.8 percentage points more likely than male workers to be engaged in informal employment, reflecting the concentration of women in unpaid family labour, domestic work, and home-based production where formal contracts are largely absent (Chen, 2006). Workers residing in urban areas are 3.9 percentage points less likely to be informally employed than rural workers, consistent with the greater presence of registered enterprises and stronger regulatory enforcement in urban labour markets (Kannan & Papola, 2007).

Among the age categories, the most notable result is the reversal observed for workers aged 60 and above, who are 3.8 percentage points more likely to be informally employed, in contrast to workers aged 30–59, who show substantial reductions in informality (6.5 and 11.8 points respectively). This reversal is consistent with the institutional structure of formal employment in India, where mandatory retirement provisions push older workers out of formal jobs and into informal, often own-account, activities to sustain their livelihoods (Rajan, 2010).

Within the education group, the most prominent relationship is the steep decline in informality associated with higher educational attainment, with graduates and above being 43.8 percentage points less likely to be informally employed than illiterate workers, the largest effect across all education categories. This finding aligns with the human capital framework, in which formal-sector employers use educational credentials as a screening mechanism, effectively excluding less-educated workers from formal employment opportunities (Becker, 1964; Mehrotra & Parida, 2017). The most prominent relationship in the caste group is for Scheduled Caste (SC) workers, 2.6 percentage points more likely to be informally employed than the general category. This is consistent with persistent occupational segmentation along caste lines, where historically disadvantaged groups remain concentrated in informal and low-skill occupations despite affirmative action policies (Thorat & Attewell, 2007).

In the industry group, the most prominent relationship is for manufacturing and industry, where workers are 31.7 percentage points less likely to be informally employed than agricultural workers, the largest effect across all industry categories. This reflects the relatively higher prevalence of registered firms, formal contracts, and labour regulation in the manufacturing sector compared to agriculture, which remains dominated by self-employment and casual labour (Mazumdar & Sarkar, 2013).

Table 1: Determinants of the informality-Logit model marginal effects

Variables	Informal workers: Marginal effects
Female (Ref. Male)	0.048*** (0.002)
Urban (Ref. Rural)	-0.039*** (0.002)
<i>Age (Ref. 15-29 years)</i>	
30-44	-0.065*** (0.002)
45-59	-0.118*** (0.002)
60 above	0.038 (0.006)
<i>Education (Ref. Illiterate)</i>	
Primary & Middle	-0.073*** (0.003)
Up to Higher Secondary	-0.207*** (0.003)
Diploma/Certificate	-0.407*** (0.006)
Graduation & above	-0.438*** (0.004)
<i>Caste (Ref. Others)</i>	
ST	-0.013*** (0.004)
SC	0.026*** (0.003)
OBC	0.018*** (0.002)
<i>Industry (Ref. Agriculture)</i>	
Manufacturing & Industry	-0.317*** (0.004)
Construction	0.045*** (0.004)
Trade & Hotels	-0.046*** (0.004)
Transport	-0.159*** (0.005)
Other Services	-0.306*** (0.004)
State and District FE	YES
Observations	180,299
R-squared	0.39

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: #Others includes Jainism, Buddhism, Zoroastrianism, & others

5.2. Impact of Training on Informal Employment

Table 2 presents the estimates from a logit model examining the association between participation in training programmes and the likelihood of being informally employed. The

dependent variable is a binary indicator taking the value one if an individual is engaged in informal employment and zero otherwise. The results indicate that participation in training is significantly associated with a lower probability of informal employment. Specifically, the estimated marginal effect suggests that individuals who have received training are approximately 4.8 percentage points less likely to be employed in the informal sector compared to otherwise similar individuals who have not undergone training, holding other observed characteristics constant. This finding highlights the potential role of skill development and vocational training in facilitating access to formal employment opportunities and reducing labour market informality.

Table 2: Training and informal employment

Variables	Informal workers: Marginal effects Base Category: No Training
Training	-0.048*** (0.017)
Controls	YES
State and District FE	YES
Observations	43,188
R-squared	0.47

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

5.3. Employment Quality and Female Workers

Table 3 examines the determinants of the quality composition of women’s employment using Multinomial Logit model. Employment quality is categorized into self-employment, regular wage employment, and casual labour, with the estimated marginal effects indicating how individual and household characteristics are associated with the probability of women being employed in each category. The results reveal substantial heterogeneity in employment outcomes across socio-economic groups. Women who are household heads are significantly more likely to be engaged in regular wage employment and less likely to be employed as casual labourers, suggesting that greater decision-making authority within the household is associated with improved employment quality. This pattern is particularly pronounced in urban areas, where household headship is linked to a sizeable shift towards regular wage employment.

The results also highlight the important role of education in shaping the quality of women’s employment. The probability of being engaged in casual labour declines steadily from 0.21 among non-literate women to 0.12 among women with middle-to-secondary education,

suggesting that education helps women move away from the most precarious forms of work. However, the more substantial transformation occurs only at the higher secondary level and above, where the probability of regular wage employment rises sharply to 0.44, while the probability of casual labour falls to just 0.03 and self-employment begins to decline. These results suggest that education operates through a two-stage process: it first leads to lower casualization of women's employment and subsequently facilitates a transition into more stable and remunerative regular wage work. The findings underscore the importance of higher levels of educational attainment in improving the quality of women's employment outcomes.

Table 3: Employment quality among female workers

Variables	Female workers and employment quality: Multinomial Logit		
	Self-Employed	Regular Wage	Casual Labour
Female headed HHD dummy	-0.001 (0.011)	0.044*** (0.007)	-0.042*** (0.007)
Not literate	0.684** (0.018)	0.103** (0.062)	0.212** (0.082)
Below Middle	0.647** (0.081)	0.161*** (0.006)	0.191** (0.077)
Middle to secondary	0.669*** (0.007)	0.204** (0.045)	0.126** (0.057)
Higher secondary & above	0.513** (0.075)	0.447*** (0.006)	0.039* (0.305)
ST	-0.108*** (0.018)	-0.013 (0.012)	0.121*** (0.011)
SC	-0.199*** (0.012)	0.054*** (0.008)	0.145*** (0.013)
OBC	-0.036*** (0.010)	-0.009 (0.007)	0.044*** (0.008)
State and District FE	YES	YES	YES
Observations	1,26,294	1,26,294	1,26,294
R-squared	0.37	0.37	0.37

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Entries under education represent predicted probabilities of being in each employment category at different levels of educational attainment, evaluated holding other covariates at their observed values.

The analysis also highlights persistent labour-market segmentation by social background. Relative to women from the others category, women belonging to SC, ST and OBC households are less likely to be self-employed and more likely to be engaged in casual labour, indicating continued concentration in lower-quality forms of employment. While SC women exhibit some

gains in regular wage employment, they simultaneously face a higher likelihood of casual labour, pointing to a polarized employment structure. Overall, the findings suggest that both intra-household agency and social background play an important role in shaping not only women's participation in the labour market but also the quality and stability of employment opportunities available to them.

5.4. ICT Adoption and Labour Productivity

Table 4 presents the estimates of the relationship between ICT adoption and labour productivity among unincorporated enterprises using ASUSE 2025 data. The coefficient on the ICT Index is 0.755 and is significant at the 1 per cent level. This suggests that enterprises with higher levels of ICT adoption tend to exhibit substantially higher labour productivity, even after controlling for a wide range of observable enterprise characteristics and location-specific factors. More precisely a one-unit increase in the normalized ICT adoption index is associated with a 76 per cent increase in labour productivity, holding all other factors constant. The magnitude of the coefficient highlights ICT adoption as one of the most important correlates of productivity among unincorporated enterprises. The control variables such as firm age is positively associated with labour productivity, implies that older firms tend to be more productive, potentially reflecting the accumulation of business experience, stronger market linkages, and learning-by-doing effects over time. Similarly, capital intensity exerts a positive and statistically significant effect on productivity. Firms with greater capital per worker achieve higher labour productivity, consistent with standard production theory where capital deepening enhances worker efficiency.

Table 4: ICT adoption and labour productivity

Variables	Labour Productivity		
	Overall	Rural	Urban
ICT Index	0.755*** (0.015)	0.521** (0.257)	0.860*** (0.018)
Constant	11.07*** (0.016)	10.534*** (0.029)	11.394*** (0.019)
Controls	YES	YES	YES
Sector	YES	NO	NO
State and District FE	YES	YES	YES
Observations	302,399	113,030	189,369
R-squared	0.53	0.46	0.68

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Ownership structure also matters for enterprise performance. Relative to sole proprietorships, partnership-owned enterprises exhibit higher labour productivity, suggesting that shared

ownership may facilitate better access to resources, managerial capabilities, and business networks. Enterprise size exhibits a linear relationship with productivity. This finding suggests that larger enterprises benefit from economies of scale, superior management practices, and greater resource availability, all of which contribute to enhanced productivity. The educational attainment of the proprietor is strongly associated with productivity outcomes. Compared with enterprises operated by illiterate proprietors, all higher educational categories show positive and statistically significant coefficients. Sectoral differences are also evident. Relative to manufacturing enterprises, firms engaged in trade and other services demonstrate significantly higher labour productivity. These sectors may require lower labour inputs relative to output or may benefit more directly from digital technologies, resulting in higher measured productivity.

5.5. ICT Adoption and Enterprise Formalisation

The logit model results examining the relationship between ICT adoption and enterprise formalization are presented in Table 5. The coefficients represent average marginal effects. The results indicate a strong and statistically significant positive association between ICT adoption and enterprise formalization across all specifications. For the overall sample, the coefficient on the ICT index is 0.834 and is statistically significant at the 1 per cent level. This implies that a one-unit increase in the normalized ICT adoption index is associated with an 83.4 percentage point increase in the probability of enterprise registration, holding all other factors constant. The result suggests that enterprises with greater adoption of digital technologies are substantially more likely to become formalized through registration (Cieřlik & van Stel, 2024; Nguimkeu & Okou, 2021).

Table 5: Impact of the ICT adoption and enterprises formalisation

Variables	Formalization: Registration Dummy (Marginal Effect)		
	Overall	Rural	Urban
ICT Index	0.834*** (0.012)	0.757*** (0.019)	0.857*** (0.015)
Controls	YES	YES	YES
Sector	YES	NO	NO
State and District FE	YES	YES	YES
Observations	308,902	116,867	192,035
Pseudo R ²	0.21	0.22	0.22

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The positive association between ICT adoption and formalization is observed across both rural and urban enterprises, although the magnitude of the effect differs across locations. For rural enterprises, the coefficient on the ICT index is 0.757, indicating that a one-unit increase in the

ICT adoption index is associated with a 75.7 percentage point increase in the probability of registration. The corresponding coefficient for urban enterprises is 0.857, implying an 85.7 percentage point increase in the probability of registration. The larger coefficient for urban enterprises suggests that the formalization benefits of ICT adoption are stronger in urban areas, possibly reflecting better digital infrastructure, greater awareness of registration procedures, and easier access to online government platforms.

Table 6: Impact of the ICT adoption and enterprises formalisation sector-wise

Variables	Formalization: Registration Dummy (Marginal Effect)		
	Manufacturing	Trade	Other Services
ICT Index	0.642*** (0.027)	0.824*** (0.240)	0.857*** (0.015)
Controls	YES	YES	YES
Sector (Rural, Urban)	YES	YES	YES
State and District FE	YES	YES	YES
Observations	59,542	92,666	156,664
Pseudo R ²	0.34	0.27	0.17

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6 presents the average marginal effects from the logit model examining the relationship between ICT adoption and enterprise formalization across manufacturing, trade, and other service sectors. The results indicate a strong and statistically significant positive association between ICT adoption and enterprise formalization across all sectors.

The estimated marginal effect of the ICT adoption index is 0.642 for manufacturing enterprises and is statistically significant at the 1 per cent level. This implies that a one-unit increase in the ICT adoption index is associated with a 64.2 percentage point increase in the probability of enterprise registration, holding other enterprise characteristics constant. The finding suggests that greater adoption of digital technologies facilitates compliance with regulatory requirements and enhances the likelihood of enterprises participating in the formal economy.

The positive relationship between ICT adoption and formalization is even stronger among trade enterprises. The estimated marginal effect of 0.824 indicates that a one-unit increase in the ICT adoption index is associated with an 82.4 percentage point increase in the probability of registration. The relatively larger magnitude may reflect the greater importance of digital payments, online transactions, and electronic record-keeping in the trade sector, which often necessitate formal registration and interaction with digital platforms.

The strongest effect is observed among enterprises engaged in other services, where the marginal effect of the ICT adoption index is 0.857. This suggests that a one-unit increase in ICT adoption is associated with an 85.7 percentage point increase in the probability of registration. Service-sector enterprises are typically more reliant on information flows, digital communication, and online service delivery, which may increase the incentives and opportunities for formal participation in the economy. These findings suggest that digital technologies can play a critical role in reducing informational and administrative barriers to registration, thereby encouraging greater integration of unincorporated enterprises into the formal economy.

5.6. Enterprise Registration and Access to Formal Credit

Table 7 presents the estimates from LPM examining the association between enterprise registration status and access to formal credit among unincorporated enterprises. Registration under an Act, local authority, licensing arrangement, or other regulatory framework may be viewed as an important step towards enterprise visibility, documentation, and formalization. The results indicate a positive and statistically significant relationship between registration and access to formal credit. After controlling for enterprise location (rural/urban), number of workers, and owned fixed assets, registered enterprises exhibit a 6.90 percentage-point higher probability of accessing formal credit relative to unregistered enterprises. Sector-wise estimates reveal that this positive association persists across all broad activity groups. Specifically, registration is associated with a 5.80 percentage-point increase in the probability of accessing formal credit in manufacturing enterprises, a 4.84 percentage-point increase in trade enterprises, and a 7.83 percentage-point increase in other service enterprises. The findings suggest that enterprise registration helps with improved access to formal financial institutions, highlighting the role of formalization in facilitating credit inclusion among unincorporated enterprises.

Table 7: Registration and access to formal credit

Variables	Registration and Formal Credit Access <i>Formal Credit= 1 if the establishment reports any outstanding formal/institutional loan; 0 otherwise</i>			
	Overall	Manufacturing	Trade	Other Services
Registered	0.069*** (0.001)	0.058*** (0.004)	0.048*** (0.003)	0.078*** (0.002)
Constant	0.004*** (0.005)	-0.096*** (0.007)	-0.062*** (0.009)	0.010 (0.007)
Controls	YES	YES	YES	YES
State and District FE	YES	YES	YES	YES

Observations	6,68,101	1,66,373	1,68,899	3,29,806
R-squared	0.4230	0.4780	0.4010	0.4170

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

Further results from regression between different registration categories and enterprise formalization practices indicate that compared to unregistered enterprises, enterprises registered under other registration frameworks exhibit formalization scores that are 3.42 points higher on average. (Table 8). The magnitude of the association increases substantially for government-linked registration mechanisms. GST-registered enterprises record formalization scores that are 13.51 points higher than unregistered enterprises, while Udyam-registered and Udyam Assist-registered enterprises score 15.45 points and 15.92 points higher, respectively. The consistently larger coefficients for GST, Udyam, and Udyam Assist registrations indicate that these registration systems are associated not merely with legal recognition but also with the adoption of deeper formal business practices, including the creation of a separate financial identity for the enterprise, improved record-keeping and accounting discipline, greater integration with the formal financial system, and participation in digital and online business activities.

Table 8: Govt.-linked Registration & Enterprise Formalisation

Variables	Formalisation Score
Other registered only	3.424*** (0.151)
GST Registered	13.508*** (0.279)
Udyam Registered	15.450*** (0.382)
Udyam Assist Registered	15.917*** (0.773)
Controls	YES
State and District FE	YES
Observations	3,15,537
R-squared	0.31

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

We further test if Udyam/ Udyam assist portal registration creates any additional credit advantage in terms of higher loan amount. Table 9 presents the results from a log-linear regression model examining whether Udyam and Udyam Assist registrations are associated with an additional credit advantage beyond that conferred by enterprise registration alone.

The results indicate a statistically significant association between Udyam-linked registrations and the scale of institutional credit accessed by enterprises. The estimated coefficient implies

that enterprises registered under Udyam or Udyam Assist have, on average, approximately 41 per cent higher formal loan amounts than otherwise comparable registered enterprises. This finding suggests that the benefits of Udyam-linked registrations extend beyond the general advantages associated with registration and may improve enterprise visibility within the formal financial system.

The descriptive statistics further reinforce this pattern. The average formal loan amount for unregistered enterprises is approximately Rs 3 lakh, increasing to about Rs 5.5 lakh for registered enterprises, and reaching nearly Rs 10 lakh for enterprises registered under Udyam or Udyam Assist. This progressive increase in average loan size across registration categories points towards a credit gradient associated with deeper forms of formalization.

Table 9: Udyam and Udyam Assist Impact on scale of Formal credit

Variables	Log Credit Amount
Udyam/Udyam Assist Registered	0.419*** (0.076)
Constant	8.64*** (0.171)
Controls	YES
State and District FE	YES
Observations	23,743
R-squared	0.31

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Furthermore, women are emerging as enterprise leaders. Table 10 presents the results for female proprietary enterprises, examining whether enterprise registration is associated with improved access to formal credit. The estimated LPM indicates that, among female proprietors, registered enterprises have a 5.6 percentage-point higher probability of accessing formal credit compared to otherwise similar unregistered enterprises. This finding suggests that registration enhances the visibility and credibility of women-owned enterprises within the formal financial system and may reduce informational barriers faced by lenders.

Table 10: Registration and Formal Credit Access among Female Proprietors

Variables	Formal Credit Access Dummy
Registered Enterprises	0.056*** (0.037)
Constant	0.007 (0.067)
Controls	YES
State and District FE	YES
Observations	155941

R-squared	0.31
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

The magnitude of this gap points towards the role of registration in strengthening the financial profile of women-owned enterprises by creating a verifiable business identity, improving documentation, and facilitating engagement with formal financial institutions.

Table 11: Female Proprietor and credit access

Variables	Formal Credit Access Dummy
Female Proprietor (Ref. Male Proprietor)	-0.024*** (0.009)
Constant	0.039*** (0.006)
Controls	YES
State and District FE	YES
Observations	6,51,830
R-squared	0.36

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

6. Summary and Conclusion

The findings from PLFS 2025 and ASUSE 2025 highlight the central role of human capital, digitalization, and formalization in shaping labour market and enterprise outcomes in India. On the labour market side, female workers are 4.8 percentage points more likely to be informally employed than men, while urban workers are 3.9 percentage points less likely to be informal than their rural counterparts. Education emerges as the strongest determinant of formal employment, with graduates being 43.8 percentage points less likely to be engaged in informal work than illiterate workers. Participation in training programmes further reduces the probability of informal employment by 4.8 percentage points, while among women, higher education substantially increases the likelihood of regular wage employment and reduces dependence on casual labour.

At the enterprise level, digital adoption is strongly associated with improved performance, with a one-unit increase in the ICT adoption index raising labour productivity by 76 per cent and increasing the probability of enterprise registration by 83.4 percentage points. The formalization benefits of ICT are particularly strong in urban areas (85.7 percentage points) and in service-sector enterprises (85.7 percentage points).

Enterprise registration is also associated with a 6.9 percentage-point higher probability of accessing formal credit, with positive effects observed across manufacturing, trade, and service

activities. Moreover, government-linked registration systems are associated with substantially deeper formalization outcomes, with GST registration increasing formalization scores by 13.5 points, Udyam registration by 15.5 points, and Udyam Assist registration by 15.9 points relative to unregistered enterprises.

Beyond registration alone, enterprises registered under Udyam or Udyam Assist access approximately 41% larger formal loans than comparable registered enterprises, with average loan amounts increasing from around ₹3 lakh for unregistered enterprises to Rs 5.5 lakh for registered enterprises and nearly Rs 10 lakh for Udyam-linked enterprises.

While female proprietors remain 2.4 percentage points less likely to access formal credit than male proprietors, registration increases the probability of formal credit access among women-owned enterprises by 5.6 percentage points.

Policy Implications

The findings carry several interconnected policy implications. First, educational investment remains the most powerful lever for reducing labour market informality, and policies that improve access to secondary and higher education, particularly for women, Scheduled Caste, and Scheduled Tribe populations, will yield formalization dividends beyond the education sector itself. Second, vocational training and skilling programmes need to be scaled up with explicit targeting of informal workers, particularly in agriculture and construction where informality is near-universal. The evidence suggests that even modest training interventions can shift workers toward more formal employment arrangements. Third, digital infrastructure and ICT access for micro and small enterprises should be treated as a formalization policy instrument, not merely a productivity tool. Programmes that subsidize digital adoption among rural and low-productivity enterprises are likely to generate downstream gains in registration, credit access, and business resilience. Fourth, the Udyam and Udyam Assist registration ecosystems should be strengthened and their outreach deepened, particularly among enterprises in trade and other services where formalization gaps remain wide. The evidence that government-linked registration significantly amplifies formal credit access makes a strong case for integrating these schemes more closely with institutional lending pipelines, including priority sector lending mandates. Fifth, and critically, gender-responsive policies are needed at both the labour market and enterprise levels. On the labour market side, interventions that

strengthen the bargaining position of women workers including minimum wage enforcement, social protection extension, and support for female-headed households, can improve employment quality. On the enterprise side, targeted credit guarantee schemes, simplified collateral requirements, and financial literacy programmes for female proprietors are necessary to close the persistent gender gap in institutional finance.

Finally, this paper highlights the analytical value of integrating worker-side and enterprise-side surveys within a common empirical framework. The PLFS and ASUSE together offer a rich and complementary lens on India's informal economy that neither survey can provide alone. Future research should explore longitudinal linkages between individual labour market trajectories and enterprise-level outcomes and investigate how state-level heterogeneity in formalization policy, digital infrastructure, and social protection shapes the national patterns documented here. As India continues its structural transformation, understanding the mechanisms through which workers and enterprises transition from informality to formality and the barriers that impede this transition remains one of the most consequential questions for both economic research and public policy.

References

- Ayyagari, M., Demirgüç-Kunt, A., & Maksimovic, V. (2010). Formal versus informal finance: Evidence from China. *Review of Financial Studies*, 23(8), 3048–3097.
- Beck, T., Demirgüç-Kunt, A., & Maksimovic, V. (2005). Financial and legal constraints to growth: Does firm size matter?. *The Journal of Finance*, 60(1), 137–177.
- Berger, A. N., & Udell, G. F. (2006). A more complete conceptual framework for SME finance. *Journal of Banking & Finance*, 30(11), 2945–2966. <https://doi.org/10.1016/j.jbankfin.2006.05.008>
- Brynjolfsson, E., & Hitt, L. M. (1996). Paradox Lost? Firm-Level Evidence on the Returns to Information Systems Spending. *Management Science*, 42(4), 541–558.
- Cieślak, J., & van Stel, A. (2024). Solo self-employment—Key policy challenges. *Journal of Economic Surveys*, 38(3), 759-792.
- Dana, L. P., Salamzadeh, A., Hadizadeh, M., Heydari, G., & Shamsoddin, S. (2022). Urban entrepreneurship and sustainable businesses in smart cities: Exploring the role

- of digital technologies. *Sustainable Technology and Entrepreneurship*, 1(2).
<https://doi.org/10.1016/j.stae.2022.100016>
- Fajnzylber, P., Maloney, W. F., & Montes-Rojas, G. V. (2011). Does formality improve micro-firm performance? Evidence from the Brazilian SIMPLES program. *Journal of Development Economics*, 94(2), 262–276.
- Jorgenson, D. W., & Stiroh, K. J. (2000). *Raising the speed limit: U.S. economic growth in the information age* (OECD Economics Department Working Papers No. 261). OECD Publishing. <https://doi.org/10.1787/561481176503>
- La Porta, R., & Shleifer, A. (2014). Informality and development. *Journal of Economic Perspectives*, 28(3), 109–126.
- Naudé, W. (2018). Urbanisation and entrepreneurship in development: Like a horse and carriage?. In *Smart futures, challenges of urbanisation, and social sustainability* (pp. 29-47). Cham: *Springer International Publishing*.
- NCEUS, (2009). *Contribution of the unorganised sector to GDP Report of the Sub Committee of a NCEUS Task Force*, Working Paper No. 2. National Commission for Enterprises in the Unorganised Sector National Commission: New Delhi
- Nguimkeu, P., & Okou, C. (2021). Leveraging digital technologies to boost productivity in the informal sector in Sub-Saharan Africa. *Review of Policy Research*, 38(6), 707-731.
- Reserve Bank of India. (2023). *Report on Trend and Progress of Banking in India 2022–23*. Mumbai: Reserve Bank of India.
- Shekar, K. C., & Joseph, K. J. (2022). Determinants of innovation and interactive learning in informal manufacturing enterprises in India. *Science and Public Policy*, 49(3), 427-440.
- Shekar, K. C., & Mansoor, K. (2020). COVID-19: Lockdown impact on informal sector in India. *Transport*, 13(86.6), 13-4.
- Shekar, K. C., & Vidyarani, K. (2025). *Impact of Digitalisation on Financial Inclusion and Firm Performance of Informal Sector in India: Pre and Post COVID Analysis* (CDS Working Paper No. 519). Centre for Development Studies.

- Stiglitz, J. E., & Weiss, A. (1981). Credit rationing in markets with imperfect information. *American Economic Review*, 71(3), 393–410.
- Stiglitz, J. E., & Weiss, A. (1981). Credit rationing in markets with imperfect information. *American Economic Review*, 71(3), 393–410
- Truong, T. D., & Bui, P. C. (2022). The lasting effect of formalization on credit access: Evidence from Vietnamese private SMEs. *Finance Research Letters*, 47, 102729.
- World Bank. (2016). World Development Report 2016: Digital Dividends. Washington, DC: World Bank.
- Zhu, F., Li, Q., Yang, S., & Balezentis, T. (2021). How ICT and R&D affect productivity? Firm level evidence for China. *Economic Research-Ekonomska Istraživanja*. <https://doi.org/10.1080/1331677X.2021.1875861>

Appendix

ICT Adoption Index

To capture the degree of enterprise digitalization, an ICT Adoption Index is constructed using Principal Component Analysis (PCA). The index is derived from 21 binary indicators capturing different dimensions of ICT usage by enterprises. These indicators include the use of computers, internet connectivity, digital communication tools, digital payment systems, online transactions, websites, mobile applications, and other ICT-related facilities available in the survey questionnaire.

Principal Component Analysis is employed to reduce the dimensionality of the ICT-related variables and to extract a composite measure that summarizes the overall level of digital adoption within an enterprise. The first principal component, which captures the maximum variation across the ICT indicators, is retained as the ICT adoption score. The Equation 1 has applied for the PCA analysis.

$$ICT\ Index_i = \sum_{j=1}^K w_j * Z_{ij} \quad (1)$$

Z_{ij} is the value of j^{th} indicator for each enterprise i and w_j is the weight for j^{th} indicator derived from the first principal component. Higher values of the ICT Index indicate greater adoption and integration of digital technologies within the enterprise.

Labour Productivity

Labour productivity is measured as Gross Value Added (GVA) generated per worker. Following the ASUSE methodology, GVA is computed as:

$$GVA_i = GO_i - IC_i \quad (2)$$

Where GO_i denotes the gross output of enterprise i and IC_i represents intermediate consumption. Since ASUSE reports information for different reference periods, GVA is annualized using the appropriate annualization factor. For enterprises reporting information for a reference period shorter than one year, the reported GVA is adjusted using the number of months the enterprise operated during the preceding 365 days. For enterprises reporting annual information, the reported GVA is retained without adjustment. Accordingly, enterprise-level GVA is computed as:

$$GVA_i = \begin{cases} VA_i * M_i, & \text{if reference period} < 4 \\ VA_i, & \text{if reference period} = 0 \end{cases} \quad (3)$$

Where GVA_i denotes the annualized gross value added of enterprise i , VA_i denotes the reported gross value added, M_i and denotes the number of months the enterprise operated during the last 365 days.

Labour productivity is subsequently computed as:

$$LP_i = \frac{GVA_i}{Workers_i} \quad (4)$$

$Workers_i$ denotes the total number of workers engaged in enterprise i . The natural logarithm of labour productivity is used in the empirical analysis.