Working Paper No. 112 l January 2026

DOI: 10.69814/wp/2026112

INTERNET ADOPTION AND GENDER PRODUCTIVITY GAP:
AN ANALYSIS OF INDIA'S UNORGANISED SECTOR

Jayati Chatterjee
Subash S.
Rajesh Raj S.N

THE GLOBAL DEVELOPMENT NETWORK
WORKING PAPER SERIES

GDN Global Development Network

The Global Development Network (GDN) is a public international organisation that supports high-quality, policy-oriented, social science research in Low- and Middle- Income Countries (LMICs), to promote better lives. Founded in 1999, GDN is headquartered in New Delhi (India), with offices in Clermont-Ferrand (France) and Arlington (USA). Learn more at www.gdn.int.

INTERNET ADOPTION AND GENDER PRODUCTIVITY GAP:

AN ANALYSIS OF INDIA'S UNORGANISED SECTOR

Jayati Chatterjee[1] and Subash S[2] and Rajesh Raj S.N. [3]

Abstract

This study examines the impact of internet adoption on labour productivity in the unorganised sector in India, focusing on gender-based productivity gaps. Prior research highlights the persistent productivity differences across male and female-led enterprises, but there is limited evidence on how ICT tools can influence these gaps. Using two rounds of the National Sample Survey Office (NSSO) data (2010-11 and 2015-16) and three rounds of the Annual Survey of Unincorporated Sector Enterprises (ASUSE) (2021-22, 2022-23, and 2023-24), we analyse patterns of internet adoption and its relationship with productivity. We observe a notable increase in internet adoption among small firms, which was previously concentrated among larger enterprises. Our findings confirm the persistence of gender-based productivity gaps; however, they also show that female-headed enterprises benefit significantly from internet use, with improved productivity outcomes. In addition to gender, other significant determinants of productivity include caste, age, location, enterprise size, and the nature of the business. The results highlight the potential of digital tools to reduce existing productivity inequalities among small firms and enhance productivity within India's unorganised sector, offering valuable insights for policies aimed at promoting inclusive digital growth.

Keywords: Internet adoption, Gender, Productivity Gap, India.

[1]Corresponding author. PhD Research Scholar, Department of Humanities and Social Sciences, IIT Madras, India. Jchatterjee95@gmail.com
[2]Professor, Department of Humanities and Social Sciences, IIT Madras, India. subash@iitm.ac.in
[3]Associate Professor, Department of Economics, Sikkim University.

1. Introduction

A substantial body of literature establishes a strong link between ICT adoption and productivity growth across countries, for instance, productivity gains from ICT-related industries in the US (Jorgenson & Stiroh, 2002; Oliner & Sichel, 2000; Timmer & van Ark, 2005), the Netherlands (Borowiecki et al., 2021), Italian firms (Hall et al., 2013; Nucci et al., 2023), and European economies (Gal et al., 2019; OECD, 2020; OECD, 2021; Gette et al., 2022). While evidence has been dominated by developed-country contexts, benefits also extend to developing economies (Fagerberg, 1994; Steinmueller, 2001), though returns may differ (Dedrick et al., 2013). Research on specific ICT tools: broadband (Grimes et al., 2012), mobile technology (Bertschek & Nibel, 2016), and internet usage (Clarke et al., 2015; Kretschmer, 2013), suggests improvements in customer service and transactional efficiency (Stansfield & Grant, 2003; Vickery et al., 2004). Yet, evidence remains concentrated on the formal sector, with limited understanding of ICT adoption among informal enterprises.

Informal firms constitute a major share of economic activity in developing countries, but often operate with low technology penetration. Female-owned enterprises are particularly disadvantaged, performing worse than male-owned firms (Gang et al., 2022; Islam & Amin, 2023) due to smaller scale, sectoral concentration, and household-based operations (Klapper & Parker, 2011; World Bank, 2009; Sabarwal & Terrell, 2008; Bardasi et al., 2011; Chaudhuri et al., 2020). Emerging work highlights gender productivity gaps within the informal sector (Gang et al., 2022; Islam & Amin, 2023). A parallel strand documents gender differences in technology adoption, driven by social norms and limited digital skills (Ahuja & Thatcher, 2005; Venkatesh & Morris, 2000; Maruping & Magni, 2012; Venkatesh et al., 2000; Dong & Zhang, 2011). However, COVID-19 accelerated digital uptake among women entrepreneurs (Torres et al., 2021), underscoring the potential of ICT in reducing gender-based productivity disparities.

Against this backdrop, we address three questions: (i) Does ICT adoption improve productivity in small informal firms in India? (ii) Which firm- and owner-level characteristics drive adoption and outcomes? (iii) Can ICT narrow gender productivity gaps? Using nationally representative informal sector data (2010-2023), we contribute to the ICT-productivity discourse by focusing on India's unorganised sector, where digital adoption remains limited but rapidly evolving. Informal activity accounts for 45% of GDP and employs around 85–90% of workers (Murthy, 2019), yet firms in this sector remain technologically underdeveloped (Mukherjee, 2018).

Recent growth in enterprises (ASUSE 2023-24), rising female participation, digital expansion, and policy initiatives, such as Digital India, CGTMSE, CLCSS, and Start-up India, make India an ideal case for examining ICT-driven productivity change.

Our findings indicate a substantial productivity premium for ICT adopters: labour productivity is higher for internet-using firms, controlling for firm characteristics. Female-owned firms exhibit lower productivity than male-owned firms; however, ICT adoption significantly reduces this gap. Female-owned firms that utilise the internet exhibit higher productivity than those that do not. Thus, ICT adoption not only enhances performance but also mitigates gender disparities in informal entrepreneurship. We propose policy measures, including targeted ICT training and digital support for women-led enterprises, to strengthen inclusive productivity growth.

The rest of the paper is organised as follows: Section 2 outlines a brief literature review. Section 3 discusses the data and provides descriptive evidence of the unorganised enterprises in the Indian economy. Section 4 presents the methodology used to understand the impact of ICT adoption on labour productivity, and it addresses the productivity differentials across gender and how ICT adoption could reduce them. Section 5 concludes the paper.

2. Literature review

2.1 ICT Adoption and Productivity

Information and communication technologies (ICT) have been central to modern economic transformation (Hall et al., 2013; Choi & Hoon Yi, 2009). Extensive macro-level evidence shows that ICT, particularly the internet, has driven economic growth in both developed and developing economies (Yousefi, 2011; Hitt & Brynjolfsson, 1996; Dedrick et al., 2013), with firms and households increasingly relying on digital tools for communication and information exchange (Vergara & Malásquez, 2023). ICT diffusion has generated spillovers across sectors, including small enterprises (Cardona et al., 2013), healthcare (Shao et al., 2022), and education (Fernández-Gutiérrez et al., 2020), and has been linked to improved output growth and productivity (Niebel, 2018; Stiroh, 2002).

Empirical work shows that ICT-intensive industries experience higher labour productivity (Stiroh, 2002), with digital adoption contributing significantly to output growth in the U.S.

(Brynjolfsson & Hitt, 2003) and improved performance across the UK and Europe (Bloom et al., 2010). Firm-level studies further document ICT-induced productivity gains across contexts. Bertschek & Niebel (2016), Borowiecki et al. (2021), and Gal et al. (2019) highlight specific technological channels, whereas Cette et al. (2022) demonstrate that ICT investment and specialist employment increase labour and total factor productivity in French firms. Evidence from Italy (Nucci et al., 2023) and Russia (Abramova & Grishchenko, 2020) supports similar links, and OECD (2021) finds particularly large gains among low-productivity firms.

Although evidence remains relatively rich for developed economies, research in developing regions is more limited due to data constraints. Nevertheless, studies such as Aboal et al. (2017) for Uruguay show that ICT investments boost productivity, while SME-focused literature similarly finds positive ICT effects on financial performance and efficiency (Mushtaq et al., 2022; Afolayan, 2016; Dutta et al., 2023; Mishrif & Khan, 2023; OECD, 2024). In the Indian context, ICT has made significant contributions to economic growth, particularly through services (Erumban & Das, 2016). However, the benefits of adoption remain primarily captured by larger firms (Gupta & Kumar, 2018), indicating a significant scope for small and informal enterprises to gain from digital integration.

2.2 Gender Gaps in Firm Performance

Gender disparities in firm performance are widely documented (Delecourt & Ng, 2021; Sabarwal & Terrell, 2008; Chaudhuri et al., 2020; Gang et al., 2022; Islam & Amin, 2023). These differences arise from observable characteristics such as access to resources, capital and market networks, as well as unobservable factors related to norms and preferences. Several studies attribute lower earnings among female-owned businesses to observable constraints (Khalife & Chalouh, 2013), inventory limitations (Delecourt & Ng, 2021), or credit misallocation (Mel et al., 2008). While some evidence shows no gender-based differences in business outcomes (Robb & Watson, 2004) or even higher female performance (Watson & Robinson, 2003; Sabarwal & Terrell, 2008), the dominant trend points to women-led firms being smaller, concentrated in low-capital and less profitable sectors (Bardasi et al., 2011; Klapper & Parker, 2011; World Bank, 2009).

Gender gaps are further shaped by lower working hours among women due to domestic responsibilities (Nix et al., 2015; Robb, 2008; Hundley, 2001; Bruhn et al., 2009; Fafchamps et

al., 2014; Delecourt & Fitzpatrick, 2019). Motivation and growth aspirations also differ, influencing profitability and expansion decisions (Coohoon et al., 2010; Klapper & Parker, 2011; Rosa et al., 1996). Recent work suggests that technology adoption and innovation may lag among women entrepreneurs (Expósito et al., 2023; Na & Shin, 2019). Although some studies find that gaps remain unexplained even after accounting for firm- and owner-level characteristics, this signals deeper systemic barriers (Hardy & Kagy, 2018).

3. Data

This study draws on five rounds of surveys from the unorganised sector conducted by the National Sample Survey Office (NSSO), specifically, two rounds from the NSS non-agricultural Enterprise Survey Rounds the 67th round and the 73rd round,(NSSO, 2010-11 and 2015-16) and three rounds from the Annual Survey of Unincorporated Sector Enterprises (ASUSE 2021-22, 2022-23, and 2023-24).[1] The survey was initially conducted by NSS, which included several rounds of enterprise surveys and other rounds of household and community surveys. In 2021, due to the demand for annual survey data, the ASUSE survey was started to provide annual data of enterprises. Both surveys had a focus only on non-agricultural enterprises[2]. These surveys are designed to systematically gather operational, financial, and structural information at the establishment level for non-agricultural manufacturing and service entities. The number of firms surveyed varied across years: 334,474 in 2010, 290,114 in 2015, 416,269 in 2021, 458,938 in 2022, and 498,024 in 2023 (the latest round). Our overall sample consisted of around 2 million firm data points, which were reduced to 1.6 million after data cleaning. In the case of the sample firms in our study, we excluded non-profit enterprises and considered only firms belonging to the major Indian states. The analysis is restricted to firms located in the 17 major states, which account for the largest share of enterprises, with Union Territories and smaller states excluded.[3]

[1] For the sake of simplicity, we refer the survey conducted during 2010 - 2011 as 2010, 2015 -16 as 2015 and so on.

[2] The non-agricultural enterprises engaged in the activities of manufacturing, construction, trading and repair services, hotels and restaurants, transport storage and communications, financial intermediation, real estate, renting and business activities, education, health and social work, other community, social and personal service activities (excluding domestic services) were covered in this survey.

[3] The states include Punjab, Haryana, Rajasthan, Uttar Pradesh, Bihar, Assam, West Bengal, Jharkhand, Odisha, Chhattisgarh, Madhya Pradesh, Gujarat, Maharashtra, Andhra Pradesh, Telangana, Karnataka, Kerala, Tamil Nadu. The states of Andhra Pradesh and Telangana have been considered as one. These states are selected out of the major states reported in the ASUSE Report 2023-24, whose percentage in the total share of enterprises in the country was more than 1.6 %.

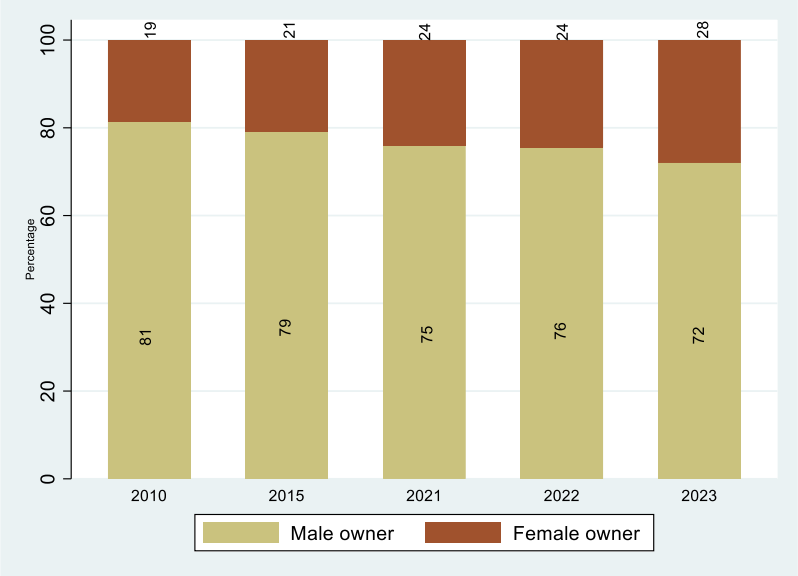
The firms that are non-partnership or non-SHG firms are only considered in our final sample, i.e the owner is a single person. Female-owned enterprises account for 19 per cent of the full sample. We consider firms less than 100 years old and have fewer than 20 workers in our final sample. The gross value added is inflation-adjusted and winsorised at the 1st and 99th percentiles. We explain below how variable used in this study is constructed.

Labour productivity is computed as the logarithmic value of the ratio of gross value added to the total number of workers. This total includes firm owners and is limited to firms with fewer than 20 workers. Regarding ownership information, the survey gathers information on the attributes. The owner characteristics include the gender of the owner and social group affiliation. The gender of the owner is a binary variable that takes the value one if the firm has a female owner, zero otherwise. The social group is defined by the social category affiliation that the owner has according to the caste definition in the society. The variable has three categories; it takes the value one if the firm owner belongs to the OBC (other backwards caste) group and the value two if the firm owner belongs to the scheduled caste (SC) or scheduled tribe (ST) category. The scheduled castes and scheduled tribes have been merged as a singular category due to the lack of enough samples in the two groups. The social group of the firm owner takes the value zero for others. The firm characteristics include the location of the firm, whether it is located within the household or outside the household, the sector (urban or rural), whether the firm is in manufacturing, and the size of the enterprise. For size, we use a dummy variable to indicate whether the firm is an own-account enterprise or a hired worker establishment. One of the other firm attributes we include is financial obstacles, which indicates if the firm has faced any financial obstacles, taking the value 1 for yes or zero otherwise. We also include state, NIC 2-digit industry and year fixed effects.

Table 1: Descriptive Statistics

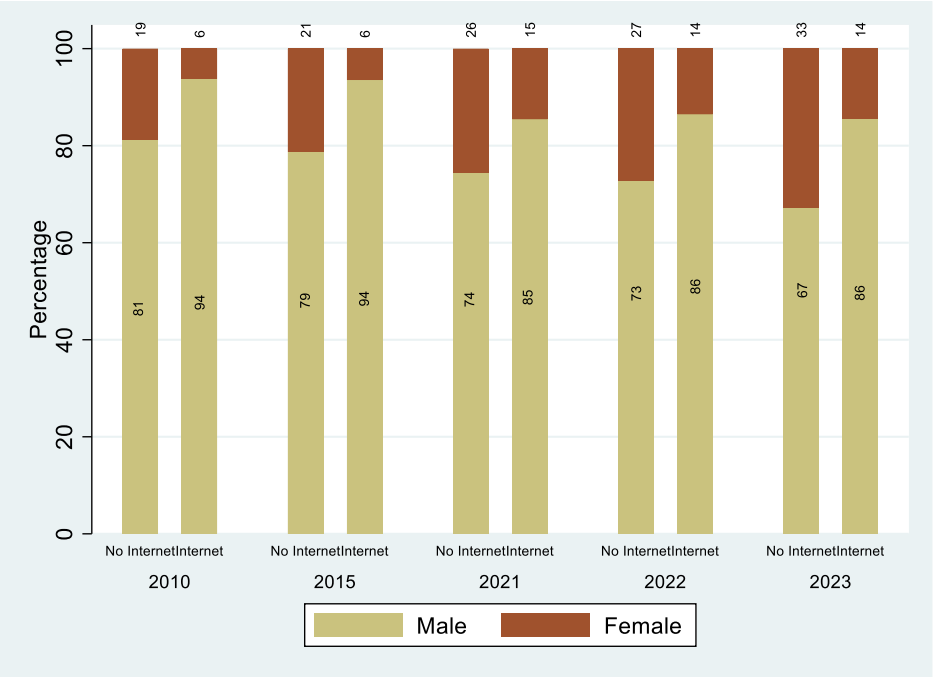
Variable	Observations	Mean	Std. Dev.	Min	Max
Log of Productivity	1606000	11.088	0.974	4.168	14.514
Proportion of Internet adopters	1606000	0.179	0.383	0	1
Proportion of Female-owned enterprises	1606000	0.19	0.392	0	1
Proportion of Own-account enterprises	1606000	0.741	0.438	0	1
Premise: Proportion of outside household	1606000	0.651	0.476	0	1
Social group					
GENERAL/OTHERS	496253	0.309	0.462	0	2
OBC	868847	0.541	0.498	0	2
SC/ST	240900	0.15	.357	0	2
Sector					
Urban	1606000	0.467	0.499	0	1
Age	1606000	11.327	8.634	1	100
Financial obstacle	1606000	0.107	0.309	0	1

Figure 1: Share of enterprises by the gender of the owner



From Figure 1[4], we observe a consistent increase in the share of female-owned enterprises, increasing from 19% in 2010 to 28% in 2023 (Figure 1). In the case of internet adopters, we observe a consistent increase among both male- and female-owned enterprises over the study period (Figure 2). The total sample includes about 17.9 per cent of internet adopters. The proportion of internet adopters is lower in the first two surveys and increases after 2021 (Figure 2).

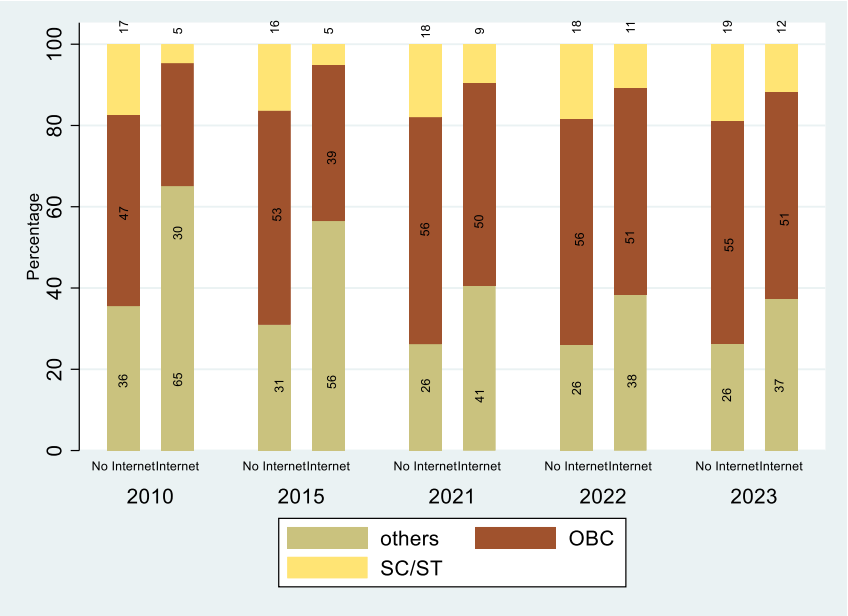
Figure 2: Internet adoption by Ownership



While the number of women entrepreneurs has grown, it is important to examine business ownership among marginalised groups. Among these groups, Other Backward Classes (OBC) account for the largest share in per cent. Figures 3 and 4 report changes in ownership and internet adoption among OBC, Scheduled Castes and Tribes (SC/ST), and others, separately for male- and female-owned firms.

[4] All graphs are weighted measures and may nit match the descriptive statistics.

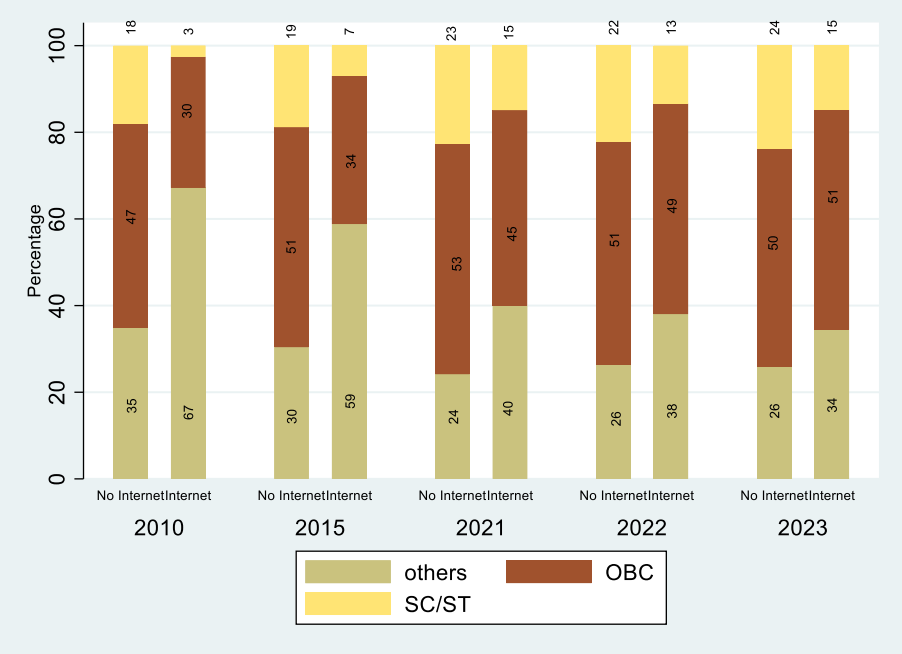
Figure 3: Share of male-owned enterprises across social groups



For non-internet users, the share of male-owned firms in the 'Others' category has declined. This decline has led to an adjustment in the OBC male owners; the percentage of OBC male owners with no internet has increased from 47 to 55. SC/ST representation has remained relatively stable at around 17-18 per cent among non-adopters. Among internet users, SC/ST enterprises increased significantly from around 5 per cent to approximately 12 per cent and OBCs from 30 per cent to around 51 per cent.

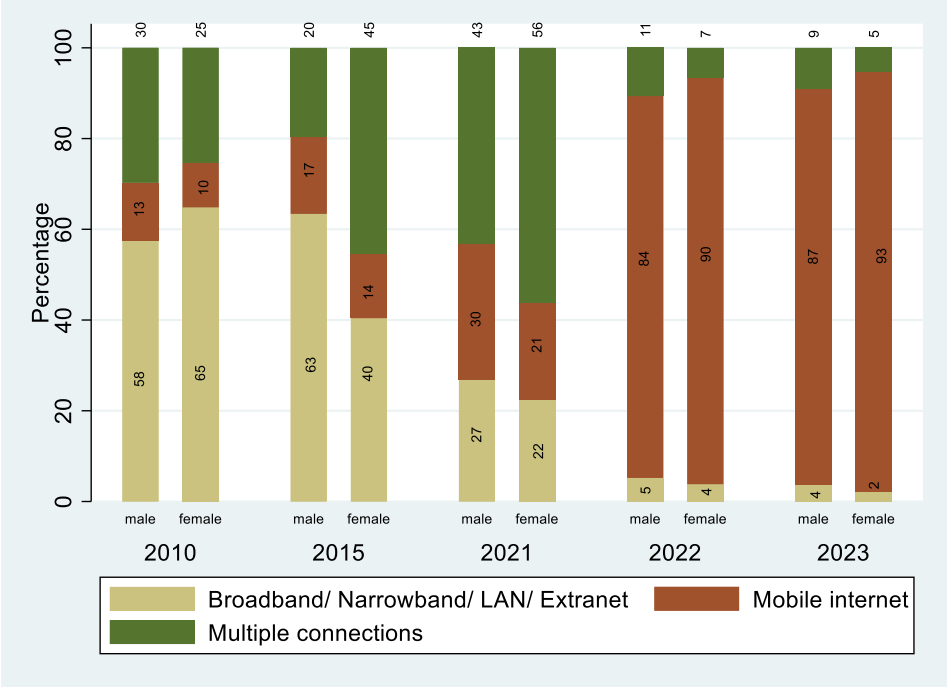
Focusing on female-owned firms (Figure 4), the female shares among SC/ST non-internet users recorded an increase from 18 per cent to 24 per cent, while the rise among OBC-owned enterprises was more modest. Internet adoption was initially concentrated among 'Others' among female-owned firms. However, over the past 15 years, the internet use of OBC-owned enterprises has increased by approximately 21 percentage points. This indicates that internet usage is no longer confined to a specific social group. Similarly, internet use among SC and ST female-owned enterprises increased by nearly 12 percentage points, suggesting a reduction in disparities in digital adoption.

Figure 4: Internet Adoption by Female-Owned Enterprises, by Social Group Affiliation



We categorise internet connections into three groups: (i) non-mobile types, which consist of narrowband, broadband, Local Area Network (LAN), and Extranet connections (ii) mobile internet, and (iii) multiple connections. The trends demonstrate a dramatic transition: non-mobile connections have sharply declined, which now constitute only around 2–4 per cent of total internet-using enterprises in recent years, across both male- and female-owned firms. This marks a clear departure from earlier years when broadband and LAN connections were more common(figure 5).

Figure 5: Type of internet connection by ownership



Mobile internet has emerged as the dominant form of internet connectivity, particularly in the past two years (Sahoo et al., 2021; Zhang &Hu, 2024). Several factors may help explain this shift. First, mobile internet is relatively affordable, making it accessible even to small and resource-constrained enterprises. Second, it requires minimal infrastructure, unlike broadband or LAN setups that often involve installation charges, hardware requirements, and technical support. In contrast, mobile data can be accessed with basic smartphones, which are now widely available[5].

Moreover, mobile internet is less susceptible to disruptions caused by external factors such as power outages or adverse weather conditions, both of which can affect fixed-line internet more severely. In many parts of the country where the electricity supply remains inconsistent, the resilience of mobile internet becomes particularly valuable for maintaining business continuity.

This pattern of transition is significant not just from a technological perspective but also from a gendered lens. Since female-owned enterprises tend to operate on a smaller scale and with

[5] According to Waghmare (2024), in 2023, 85 % of Indians reported having a smartphone, and only in 2023, eight out of ten homes were connected to the internet.

limited resources, the availability of affordable mobile internet is likely to have played a crucial role in enabling their participation in the digital economy.

4. Methodology

Before proceeding to the empirical estimation, to understand the relationship between digitalisation and labour productivity, we begin by conducting an exploratory analysis of our data using a Kernel density plot. Subsequently, we employ the OLS estimation method, followed by instrumental variable (IV) analysis, to investigate the determinants of productivity. For this purpose, we utilise five rounds of data.

We estimate the following OLS model:

$$lnLP_{ijst} = \alpha_1 + \alpha_2 \times Gender_{ijst} + \alpha_3 \times ICT_{ijst} + \alpha_4 \times Gender_{ijst} \times ICT_{ijst} + \alpha_5 \times X_{ijst} + \alpha_6 \times Z_{ijt} + \mu_{ijt}$$

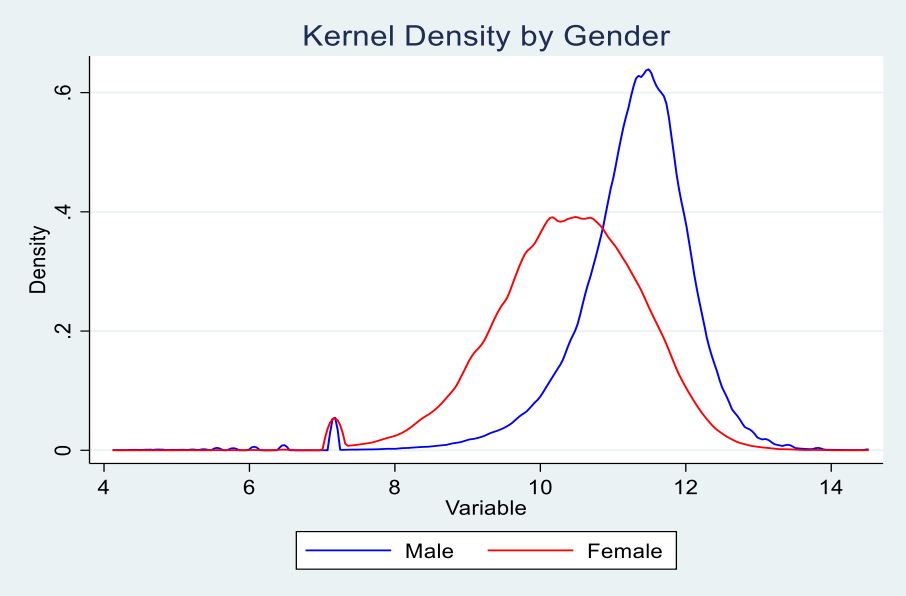
The *dependent* variable is the log of labour productivity (GVA divided by hired labour, including the owner) belonging to the i-th firm with two-digit NIC code *j*, in a particular state at time *t*. The gender of the owner is a dummy variable, which takes the value 1 for female-owned firms and zero otherwise. The variable ICT proxies for internet adoption and takes the value 1 for adopters and zero for non-adopters. The interaction term between gender and ICT captures whether the effect of internet adoption in female-owned firms has a positive or a negative impact on productivity compared to female-owned firms without internet. The vector *X* includes host of other firm controls including age of the firm, social group of the owner, premises of the enterprise (within household or outside), type of enterprises (hired worker establishment or own account enterprise) and location (rural or urban), type of industry (manufacturing or non-manufacturing) while vector Z captures the state, year and two-digit industry fixed effects. The differences in the industry, state and year would be captured by the vector Z.

5. Results

5.1 Kernel density distribution

To explore gender disparities in productivity, we present the kernel density plot (Figure 7). This figure illustrates the difference in productivity distribution between male- and female-owned firms, which prompts us to proceed with estimating our baseline model. We observe that at lower productivity levels, the distribution of male-owned and female-owned firms is similar. A wider gap is observed in the lower tail, extending toward the middle of the distribution. However, in the upper tail, the productivity gap between male- and female-owned firms becomes nearly identical. These findings suggest that gender differences in productivity are more pronounced among firms in the lower and middle segments of the productivity distribution. The kernel density plots reveal that women-led enterprises tend to have lower maximum productivity levels, with their productivity distribution peaking at relatively low values. In contrast, male-led enterprises exhibit higher peaks at greater productivity levels, indicating a higher concentration of male-led firms achieving better productivity outcomes.

Figure 7: Kernel densities of productivity distribution



Note: Kernel densities are computed for equispaced points using an Epanenchnikov kernel
The X-axis measures the lnLP or the log of labour productivity, which is indicated as a variable in the figure.

5.2 Results

This section presents our results, including those from OLS and IV estimation. Table 2 (Col 1) presents the OLS estimation results with the independent variable internet, which is statistically significant at the one per cent level. Excluding the controls, the labour productivity gap among internet adopter and non-adopter firms is 0.736. The estimated coefficient value implies that the labour productivity of firms with internet adopters is about 73.6 per cent higher compared to a non-adopter. In column 2, upon introducing the ownership variable, the gap between internet adopters and non-adopters is observed as 0.624. The productivity of female owners is 0.993, which is less than that of male owners when we introduce the ownership dummy (gender of the owner). After exponentiating the coefficient[6], the results suggest that female-owned enterprises have, on average, 63% lower labour productivity than male-owned enterprises. This finding points to a significant gender disparity in firm productivity.

[6] The exponential is calculated using $percentage\ change = \left(e^{\beta} - 1\right) * 100$, where β is the coefficient.

Table 2: Regression results

	(1) Labour productivity	(2) Labour productivity	(3) Labour productivity	(4) Labour productivity
Internet	0.736***	0.624***	0.3***	0.281***
	(0.024)	(0.021)	(0.013)	(0.013)
Female owner		-0.993***	-0.692***	-0.684***
		(0.021)	(0.02)	(0.019)
Internet × Gender			0.191***	0.198***
			(0.025)	(0.025)
OBC			-0.088***	-0.082***
			(0.009)	(0.009)
SC/ST			-0.261***	-0.253***
			(0.017)	(0.017)
Premise: Outside the household			0.248***	0.236***
			(0.011)	(0.011)
Sector: Urban			0.305***	0.298***
			(0.012)	(0.012)
Hired worker establishment			-1.166***	-1.173***
			(0.403)	(0.402)
Manufacturing			0.077***	0.077***
			(0.006)	(0.006)
Log age				0.103***
				(0.01)
Financial obstacle				0.029**
				(0.013)
State fixed effects		Yes	Yes	Yes
Year fixed effects		Yes	Yes	Yes
Industry fixed effects		Yes	Yes	Yes
Constant	10.845***	11.092***	10.509***	10.499***
	(.021)	(.016)	(.044)	(.044)
Observations	1606000	1606000	1606000	1606000
R-squared	0.059	0.221	0.359	0.361

Clustered standard errors are in parentheses.
**** p<.01, ** p<.05, * p<.1*

In column 3 and 4, we introduce the interaction term between gender and the internet. The coefficient on the interaction term, 0.198 (column 4), implies that female-owned firms with internet adoption have a positive effect on productivity. After transforming the exponent term[7], this translates to an estimated 21.9% increase in labour productivity relative to the baseline, beyond the individual effects of each variable. Thus, with the adoption of the

[7] The exponential is calculated using $percentage\ change = \left(e^{\beta} - 1\right) * 100$, where β is the coefficient.

internet, the labour productivity gap reduces in the case of female-owned firms. Regarding our other controls, we observe that older firms are more productive than younger firms. Firms in urban areas, as well as hired worker establishments and those outside household premises, exhibit higher productivity. The social group affiliation also impacts labour productivity, and labour productivity varies across the groups. The base group refers to the general population, which is seen to be more productive than both the OBC owners and the SC/ST owners. The owners belonging to the OBC category are seen to be 8 per cent less productive than the base group, while the owners of the SC/ST community are almost 25 per cent less productive than the base group. These reasons for their low productivity may be due to their size and type of industry (Chaudhuri et al, 2020). After controlling for this set of firm characteristics, the gap in labour productivity between male and female-owned firms is almost 50 per cent. However, the interaction term indicates that the adoption of the internet in a female-owned firm results in a 12 per cent higher productivity, after controlling for other firm-specific characteristics.

6. Conclusion

This paper attempts to examine the association between internet adoption, the gender of the owner and productivity differentials. This paper examines the impact of internet use on productivity in micro, small, and medium enterprises (MSMEs), with a particular focus on the gender of the firm owner.

Using a rich, 5-year pooled dataset spanning a 14-year period, we present three key findings. First, we observe that internet adopters have higher productivity across all models, indicating that firms that use the internet are more productive. Secondly, female-owned firms exhibit 45-50 per cent lower productivity than male-owned firms on average; this gap narrows substantially, though it does not fully disappear, when women-led firms adopt digital technologies. The effects are economically meaningful: internet-using female-owned firms achieve productivity levels comparable to the median male-owned firm in our sample. The results hold when controlling for firm age, sector, urban location, and size. Third, higher productivity exhibits striking heterogeneity across social groups.

Contrary to concerns that digitalisation might exacerbate disparities, we demonstrate that basic digital adoption can help mitigate gender gaps in small and medium-sized enterprises in the unorganised sector. We find that female-owned firms that adopt the internet show

marked improvements, indicating that technology can help offset structural disadvantages. Further, productivity varies across social groups, with older, urban, and externally managed firms demonstrating higher efficiency. Our study suffers from some limitations and leaves scope for further research in the future. First, our data cannot distinguish between types of internet usage (e.g., e-commerce versus information search), leaving the "how" of productivity gains as unknown. Second, the post-2016 period, marked by the internet revolution coupled with demonetization, may represent a structural break that we cannot fully explore due to the unavailability of panel data.

References

Aboal, D. & Tacsir, E. (2015). Innovation and productivity in services and manufacturing : The role of ICT investment. *MERIT Working Papers*. https://ideas.repec.org/p/unm/unumer/2015012.html

Abramova, N., & Grishchenko, N. (2020). ICTs, Labour Productivity and Employment: Sustainability in Industries in Russia. *Procedia Manufacturing*, *43*, 299–305. https://doi.org/10.1016/j.promfg.2020.02.161

Annual Survey of Unincorporated Sector Enterprises (ASUSE) of 2021-2022 India. (2024). National Sample Survey Office. https://microdata.gov.in/NADA/index.php/catalog/ENT/?page=1&sort_order=desc&ps=15&repo=ENT

Annual Survey of Unincorporated Sector Enterprises (ASUSE) of 2022-2023 India. (2024). National Sample Survey Office. https://microdata.gov.in/NADA/index.php/catalog/ENT/?page=1&sort_order=desc&ps=15&repo=ENT

Annual Survey of Unincorporated Sector Enterprises (ASUSE) of 2023-2024 India. (2025). National Sample Survey Office. https://microdata.gov.in/NADA/index.php/catalog/ENT/?page=1&sort_order=desc&ps=15&repo=ENT

Bardasi, E., Sabarwal, S., & Terrell, K. (2011). How do female entrepreneurs perform? Evidence from three developing regions. *Small Business Economics*, *37*(4), 417–441. https://doi.org/10.1007/s11187-011-9374-z

Bassanini, A., & Scarpetta, S. (2002). Does human capital matter for growth in OECD countries? A pooled mean-group approach. *Economics Letters*, *74*(3), 399–405. https://doi.org/10.1016/s0165-1765(01)00569-9

Bertschek, I., & Niebel, T. (2016). Mobile and more productive? Firm-level evidence on the

productivity effects of mobile internet use. *Telecommunications Policy*, *40*(9), 888–898. https://doi.org/10.1016/j.telpol.2016.05.007

Borowiecki, M., Pareliussen, J., Glocker, D., Kim, E. J., Polder, M., & Rud, I. (2024). *The impact of digitalisation on productivity: Firm-level evidence from the Netherlands*. OECD. https://www.oecd.org/en/publications/the-impact-of-digitalisation-on-productivity-firm-level-evidence-from-the-netherlands_e800ee1d-en.html

Cardona, M., Kretschmer, T., & Strobel, T. (2013). ICT and productivity: conclusions from the empirical literature. *Information Economics and Policy*, *25*(3), 109–125. https://doi.org/10.1016/j.infoecopol.2012.12.002

Clarke, G. R. G., Qiang, C. Z., & Xu, L. C. (2015). The Internet as a general-purpose technology: Firm-level evidence from around the world. *Economics Letters*, *135*, 24–27. https://doi.org/10.1016/j.econlet.2015.07.004

Dutta, N., & Sobel, R. (2016). Does corruption ever help entrepreneurship? *Small Business Economics*, *47*(1), 179–199. https://doi.org/10.1007/s11187-016-9728-7

Fagerberg, J. (1994). Technology and International Differences in Growth Rates. *Journal of Economic Literature*, *32*(3), 1147–1175. https://www.jstor.org/stable/2728605

Gal, P., Nicoletti, G., Renault, T., Sorbe, S., & Timiliotis, C. (2025). *Digitalisation and productivity: In search of the holy grail – Firm-level empirical evidence from EU countries*. OECD. https://www.oecd.org/en/publications/digitalisation-and-productivity-in-search-of-the-holy-grail-firm-level-empirical-evidence-from-eu-countries_5080f4b6-en.html

Gang, I., Natarajan, R. R., Sen, K., & Yun, M.-S. (2022). Does the Gender of the Owner Affect the Productivity of Enterprises in India's Informal Economy? *Journal of Income Distribution*, *31(3-4)*. https://doi.org/10.25071/1874-6322.40548

Grimes, A., Ren, C., & Stevens, P. (2012). The need for speed: impacts of internet connectivity on firm productivity. *Journal of Productivity Analysis*, *37*(2), 187–201. JSTOR. https://doi.org/10.2307/43549652

Hall, B. H., Lotti, F., & Mairesse, J. (2013). Evidence on the impact of R&D and ICT investments on innovation and productivity in Italian firms. *Economics of Innovation and New Technology*, *22*(3), 300–328. https://doi.org/10.1080/10438599.2012.708134

Haller, S., & Siedschlag, I. (2011). Determinants of ICT adoption: evidence from firm-level data. *Applied Economics*, *43*(26), 3775–3788. https://ideas.repec.org/a/taf/applec/v43y2011i26p3775-3788.html

Hitt, L. M., & Brynjolfsson, E. (1996). Productivity, Business Profitability, and Consumer Surplus: Three Different Measures of Information Technology Value. *MIS Quarterly*, *20*(2), 121. https://doi.org/10.2307/249475

Intarakumnerd, P., & Goto, A. (2016). Technology and Innovation Policies for Small and Medium-Sized Enterprises in East Asia. *ADBI Working Paper Series No. 578*. Asian Development Bank Institute. https://doi.org/10.2139/ssrn.2812432

Islam, A. M., & Amin, M. (2023). The gender labor productivity gap across informal firms. *World Development*, *167*, 106229. https://doi.org/10.1016/j.worlddev.2023.106229

Jorgenson, D. W., & Stiroh, K. J. (2000). U.S. Economic Growth at the Industry Level. *American Economic Review*, *90*(2), 161–167. https://doi.org/10.1257/aer.90.2.161

Mallick, S., & Yang, Y. (2013). Productivity Performance of Export Market Entry and Exit: Evidence from Indian Firms. *Review of International Economics*, *21*(4), 809–824. https://doi.org/10.1111/roie.12072

Miller, B., & Atkinson, R. D. (2014). Raising European Productivity Growth Through ICT. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3079844

Mukherjee, S. (2018). Challenges to Indian micro small scale and medium enterprises in the era of globalization. *Journal of Global Entrepreneurship Research*, *8*(1). springer. https://doi.org/10.1186/s40497-018-0115-5

Nucci, F., Puccioni, C., & Ricchi, O. (2023). Digital technologies and productivity: A firm-level investigation. *Economic Modelling*, *128*, 106524–106524.

https://doi.org/10.1016/j.econmod.2023.106524

OECD. (2020). OECD Digital Economy Outlook 2020. *OECD Publishing, Paris*. https://doi.org/10.1787/bb167041-en

Oliner, S. D., & Sichel, D. E. (2000). The Resurgence of Growth in the Late 1990s: Is Information Technology the Story? *Journal of Economic Perspectives*, *14*(4), 3–22. https://doi.org/10.1257/jep.14.4.3

Pachouri, A., & Sharma, S. (2016). *ADBI Working Paper Series Barriers to Innovation in Indian Small and Medium-Sized Enterprises* . Asian Development Bank Institute. https://www.adb.org/sites/default/files/publication/189392/adbi-wp588.pdf

Sabarwal, S., & Terrell, K. (2008). Does Gender Matter for Firm Performance? Evidence from Eastern Europe and Central Asia. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1286696

Stansfield, M., & Grant, K. (2003). An Investigation into Issues Influencing the Use of the Internet and Electronic Commerce amoung Small-Medium Sized Enterpirses. *Journal of Electronic Commerce Research*, *4*(1), 15–33. https://discovery.dundee.ac.uk/en/publications/an-investigation-into-issues-influencing-the-use-of-the-internet-

Steinmuller, W. E. (2001). ICTs and the possibilities for leapfrogging by developing countries. *International Labour Review*, *140*(2), 193–210. https://doi.org/10.1111/j.1564-913x.2001.tb00220.x

Torres, J., Maduko, F. O., Gaddis, I., Iacovone, L., & Beegle, K. G. (2021). The Impact of the COVID-19 Pandemic on Women-Led Businesses. *Policy Research Working Paper Series, 9817*. The World Bank. https://ideas.repec.org/p/wbk/wbrwps/9817.html

Unincorporated Non-Agricultural Enterprises (Excluding Construction) - JULY 2010 - JUNE 2011 73 round India. (2011). National Sample Survey Office. https://microdata.gov.in/NADA/index.php/catalog/ENT/?page=1&sort_order=desc&ps=15&repo=ENT

Unincorporated Non-Agricultural Enterprises (Excluding Construction) - JULY 2015 - JUNE 2016 73

round India. (2016). National Sample Survey Office. https://microdata.gov.in/NADA/index.php/catalog/ENT/?page=1&sort_order=desc&ps=15&repo=ENT

Vickery , G., Sakai, K., Lee, I., & Sim, H. (2004). ICT, E-Business and Small and Medium Enterprises. *OECD Digital Economy Papers No. 86*. OECD. https://doi.org/10.1787/232556551425

Scan the QR Code to visit www.gdn.int
or write to communications@gdn.int for more information.

GDN Global Development Network

INDIA: 2nd Floor, West Wing ISID Complex, 4,
Vasant Kunj Institutional Area, New Delhi-110070, India

EUROPE: 63 Boulevard François Mitterrand - CS 50320,
63009 Clermont-Ferrand Cedex, France

US: Clifton Larson Allen LLP, 901 N. Glebe Road,
Suite 200, Arlington, VA 22203, USA