



Digitalisation and women's entrepreneurial participation in India: A state-level empirical analysis

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Abstract

Digital technologies are increasingly regarded as an enabler of entrepreneurship because they can reduce information, transaction and market-access constraints. For women entrepreneurs, however, digital access may not automatically translate into greater entrepreneurial participation because technology adoption interacts with income, labour-market participation, skills and institutional conditions. This study examines whether greater digitalisation is associated with women's entrepreneurial participation across Indian states. A data-availability assessment was first undertaken using official sources. Because a fully comparable state-level panel could not be constructed without combining differently defined administrative series, the empirical analysis uses a cross-section of 28 Indian states. Women's entrepreneurship is measured primarily by the percentage of women-owned MSMEs among MSMEs registered through Udyam Registration/Udyam Assist during July 2020–November 2024. Digitalisation is measured by internet subscribers per 100 population at December 2023. Female labour-force participation and lagged per-capita state income are included as socioeconomic controls. Descriptive statistics, correlation analysis and heteroskedasticity-robust OLS regression are employed. The results show substantial interstate variation in both digital connectivity and women's entrepreneurial participation. Contrary to the expected positive relationship, internet penetration is not positively associated with the share of women-owned MSMEs after controlling for female labour-force participation and income. A robustness specification using the logarithm of new women-led MSME registrations also fails to establish a positive effect. The findings suggest that digital infrastructure alone may be insufficient to increase women's entrepreneurship and that digital capability, finance, market access and institutional support require simultaneous attention.

Keywords: Women's entrepreneurship, digitalisation, MSMEs, internet penetration, Udyam Registration, India

Introduction

Digitalisation has become an increasingly important component of India's economic transformation. Expansion of mobile connectivity, broadband infrastructure, digital payments and online platforms has reduced the cost of accessing information, communicating with customers and conducting business transactions. These developments have particular relevance for micro and small enterprises, where digital tools can potentially compensate for limitations in physical infrastructure and conventional market networks.

The potential significance is especially high for women entrepreneurs. Women frequently face constraints related to mobility, access to finance, business networks, information and market opportunities. Digital technologies can theoretically reduce some of these barriers by allowing entrepreneurs to advertise through social media, communicate remotely with customers, accept digital payments and access geographically dispersed markets. Recent qualitative research has documented how women entrepreneurs develop digital capabilities and use social media to sustain small businesses (Nielsen, 2021). More recent Indian research similarly indicates that digital engagement and financial technology can contribute to entrepreneurial inclusion, although the benefits depend on women's capabilities and the institutional environment. A 2025 study of Indian digital women entrepreneurs, for example, found that digital reliance was associated with outcomes such as sales growth and market expansion, but within a framework of resource orchestration rather than technology access alone.

The Indian policy environment has simultaneously placed strong emphasis on formalising micro enterprises. The Udyam Registration system, introduced in July 2020, and

the subsequent Udyam Assist Platform have substantially expanded the administrative visibility of micro enterprises. Government data indicate a rapid increase in women-led MSME registrations. During 2021–22, 908,488 women-led MSMEs were registered on the Udyam portal; the corresponding figures were 1,484,512 in 2022–23 and 2,298,577 in 2023–24.

Nevertheless, an increase in digital connectivity and an increase in women's enterprise registration do not by themselves demonstrate that digitalisation promotes women's entrepreneurship. Digital access can be concentrated in economically advanced states, while women's entrepreneurship may be shaped by broader socioeconomic and institutional factors. Furthermore, administrative registration data measure formalisation and registration behaviour rather than the entire population of women entrepreneurs.

Against this background, this study examines whether interstate differences in digitalisation are associated with differences in women's entrepreneurial participation in India. The study deliberately avoids causal language and focuses on statistical association.

Literature Review and Research Gap

Research on digitalisation and women's entrepreneurship has developed along several related strands. The first examines digital adoption within women-owned small businesses. Nielsen's study of women entrepreneurs found that digitalisation requires learning, experimentation and development of practical digital skills rather than merely obtaining technological access. Social media use became part of entrepreneurial activity through processes of learning and adaptation.

A second strand focuses on digital platforms and entrepreneurial outcomes. Recent research increasingly treats digital technology as a resource that entrepreneurs combine with knowledge, networks, finance and organisational capabilities. An Indian study published in 2025 examined 213 digital women entrepreneurs and reported relationships between digital reliance and business outcomes including sales growth, market expansion and product offerings. Importantly, the study conceptualised digital technology through resource orchestration rather than as an independent source of entrepreneurial success.

A third strand concerns financial digitalisation. The expansion of fintech and digital financial services can reduce transaction costs and potentially address gendered financial constraints. Recent Indian evidence on digital financial engagement argues that fintech can contribute to narrowing the gendered entrepreneurial financial gap.

More recent longitudinal evidence also cautions against equating technology adoption with entrepreneurial success. A 2026 study of women entrepreneurs in South India found that technology initially served as a survival mechanism during the pandemic but became more systematically embedded in business practices over time. Sustained growth was associated with technology combined with internal resources, family support, social networks and experiential learning.

This literature produces an important empirical implication. Digitalisation is unlikely to have a uniform effect across entrepreneurial populations. Internet access provides an enabling infrastructure, but the conversion of access into entrepreneurship depends on complementary capabilities and socioeconomic resources.

For India, a further issue is measurement. Much of the recent literature is based on surveys, interviews or samples of digitally active women entrepreneurs. Such studies provide valuable evidence about mechanisms but do not establish whether states with greater digital connectivity also exhibit greater aggregate women's entrepreneurial participation. Conversely, administrative MSME statistics provide broad interstate coverage but have seldom been integrated directly with state-level digitalisation indicators in a transparent secondary-data framework.

The present study addresses this narrower empirical gap. It does not claim that women's entrepreneurship in India has been ignored in previous research. Instead, it asks a specific question that can be examined with administrative data: after accounting for female labour-force participation and state income, is greater internet penetration associated with greater women's entrepreneurial participation across Indian states?

The study also contributes methodologically by conducting an explicit data comparability assessment before selecting the empirical design. Udyam data record registrations, while TRAI reports telecommunications indicators using service-area and state/UT classifications that have changed in some contexts. Consequently, constructing a long state panel without carefully reconciling definitions could create artificial observations. The present analysis therefore adopts a more conservative cross-sectional specification.

Objectives and Hypotheses

The study has four objectives:

1. To examine interstate variation in women's entrepreneurial participation in India.
2. To examine interstate variation in internet penetration as an indicator of digitalisation.
3. To assess the statistical association between digitalisation and women's entrepreneurial participation after accounting for female labour-force participation and state income.
4. To determine whether the empirical evidence supports the proposition that greater digitalisation is associated with greater women's entrepreneurial participation.

The following hypotheses are formulated:

H1: Greater internet penetration is positively associated with women's entrepreneurial participation.

H2: Female labour-force participation is positively associated with women's entrepreneurial participation.

H3: Higher state income is positively associated with women's entrepreneurial participation.

Because the study is cross-sectional and observational, rejection or non-rejection of these hypotheses is interpreted as evidence concerning association rather than causality.

Research Methodology

1. Data audit and study design

A preliminary assessment was conducted of official secondary-data sources. The Ministry of MSME/PIB provides state-wise annual numbers of women-led MSMEs registered through Udyam during 2021–22, 2022–23 and 2023–24. TRAI provides state/UT-wise internet subscribers per 100 population, including comparable December 2021, December 2022 and December 2023 observations.

A longer 2015–16 to 2024–25 panel was considered but rejected because the relevant women's entrepreneurship series does not provide a consistently comparable measure over the entire period. Udyam itself began in July 2020, and the available women-led registration series is a registration flow rather than a consistent stock of active enterprises. In addition, TRAI's historical state/service-area definitions sometimes combine states—for example, Andhra Pradesh with Telangana and Maharashtra with Goa in particular series—which makes mechanical panel matching inappropriate.

Accordingly, the final empirical analysis uses 28 states for which the relevant 2023–24 women's MSME, December 2023 internet, female LFPR and income information can be matched.

2. Dependent variable

The principal dependent variable is women's entrepreneurial participation (WEP), measured as the percentage of MSMEs that are women-owned during the cumulative Udyam/Udyam Assist period from 1 July 2020 to 30 November 2024.

This measure has two advantages. First, it reduces the population-size bias inherent in using absolute registration counts. Second, it captures the representation of women-owned enterprises within the formalised MSME population. The Ministry of MSME reported 22,073,675 women-owned MSMEs nationally during this period, representing 40% of registered MSMEs. Interstate shares ranged from 22% in

Himachal Pradesh to 66% in Tripura among the states used in the present analysis.

As a robustness check, the logarithm of new women-led Udyam registrations during 2023–24 is also analysed.

3. Independent variable

Digitalisation is represented by internet subscribers per 100 population at December 2023. TRAI reports this as internet tele-density. It is preferable to a simple mobile-subscription measure because it directly captures internet connectivity relevant to online entrepreneurial activities. The December 2023 national value was 67.03 subscribers per 100 population, with substantial interstate variation.

A composite Digitalisation Index was not constructed because the available state-level indicators could not be matched consistently across the selected period without introducing substantial measurement assumptions. The use

of a single transparent digitalisation indicator therefore improves reproducibility.

4. Control variables

Two controls are included.

Female labour-force participation (FLFP) is measured using the female LFPR for 2023–24 from PLFS. Female LFPR varies substantially across states, from 18.8% in Haryana to 56.9% in Sikkim in the selected sample.

Per-capita NSDP is used as a measure of state economic development. To reduce contemporaneous reverse-causality concerns, the study uses the latest broadly available state-level figure preceding the main entrepreneurship observation—2021–22 per-capita NSDP at current prices. RBI's state statistics provide the relevant series.

5. Econometric specification

The principal cross-sectional model is:

$$[WEP_i = \beta_0 + \beta_1 \text{Internet}_i + \beta_2 \text{FLFP}_i + \beta_3 \ln(\text{Income}_i) + \epsilon_i]$$

Where (i) represents the state.

A second model replaces WEP with the logarithm of new women-led MSME registrations during 2023–24:

$$[\ln(\text{WomenRegistrations}_i) = \beta_0 + \beta_1 \text{Internet}_i + \beta_2 \text{FLFP}_i + \beta_3 \ln(\text{Income}_i) + \epsilon_i]$$

Descriptive statistics and Pearson correlations are reported. OLS coefficients are estimated with heteroskedasticity-robust HC1 standard errors. Variance inflation factors are examined as a multicollinearity diagnostic.

Results and Analysis

1. Descriptive statistics

Table 1: Descriptive statistics

Variable	N	Mean	SD	Minimum	Maximum
Women-owned MSME share (%)	28	42.46	11.20	22.00	66.00
Internet subscribers/100 population	28	73.32	22.12	40.85	144.59
Female LFPR (%)	28	36.03	9.42	18.80	56.90
Per-capita NSDP (₹)	28	187,176	103,055	49,470	472,543

The distribution indicates that digitalisation is not uniform across India. States with very high internet penetration do not necessarily have the highest shares of women-owned MSMEs. This immediately cautions against interpreting digital infrastructure as a sufficient condition for women's entrepreneurial participation.

2. Correlation analysis

Table 2: Pearson correlation matrix

Variable	WEP	Internet	FLFP	ln Income
WEP	1.000	-0.189	-0.006	-0.186
Internet	-0.189	1.000	-0.164	0.822
FLFP	-0.006	-0.164	1.000	0.136
ln Income	-0.186	0.822	0.136	1.000

The bivariate relationship between internet penetration and the women-owned MSME share is weakly negative rather than positive. The relationship is not statistically sufficient to support H1. Internet penetration is strongly correlated with state income ($r = 0.822$), suggesting that digital

Table 1 demonstrates substantial interstate heterogeneity. The mean women-owned MSME share is 42.46%, while the standard deviation is 11.20 percentage points. Internet penetration averages 73.32 subscribers per 100 population, but ranges from 40.85 in Bihar to 144.59 in Goa. Female LFPR ranges from 18.8% to 56.9%.

infrastructure is partly embedded within broader economic development.

This relatively high correlation also justifies caution in interpreting individual regression coefficients.

3. Regression results

Table 3 reports the principal regression using the women-owned MSME share as the dependent variable.

Table 3: OLS regression: women's entrepreneurial participation

Variable	Coefficient	Robust SE	p-value
Constant	68.314	76.804	.374
Internet penetration	-0.063	0.219	.774
Female LFPR	-0.018	0.322	.955
ln per-capita NSDP	-1.714	8.243	.835
R ²	0.039		
Adjusted R ²	-0.081		
N	28		
Robust F-test p-value			.588

The coefficient on internet penetration is -0.063 and statistically insignificant ($p = .774$). Thus, after accounting for female labour-force participation and state income, the analysis finds no statistically significant positive association between internet penetration and the share of women-owned MSMEs.

H1 is therefore not supported. H2 and H3 are also not supported in this particular specification. The low R^2 indicates that these three variables explain little of the interstate variation in the women-owned MSME share.

The diagnostic analysis produces VIF values of approximately 4.05 for internet penetration, 1.34 for female LFPR and 4.02 for income. Thus, multicollinearity is noticeable between digitalisation and income but is below the conventional threshold of severe multicollinearity.

4. Robustness analysis

A second model uses the logarithm of new women-led Udyam registrations during 2023–24 as the dependent variable.

Table 4: Robustness regression: new women-led MSME registrations

Variable	Coefficient	Robust SE	p-value
Constant	-0.832	10.399	.936
Internet penetration	-0.053	0.029	.063
Female LFPR	-0.116	0.031	<.001
ln per-capita NSDP	1.617	1.060	.127
R^2	0.408		
Adjusted R^2	0.334		
N	28		
Robust F-test p-value			.008

The robustness model provides a different picture of the determinants of absolute registration flows. Internet penetration remains negative and is marginally significant at the 10% level, while female LFPR has a statistically significant negative coefficient. Per-capita income is positive but statistically insignificant.

The difference between the principal and robustness specifications is substantively important. It shows that conclusions can depend on how women's entrepreneurship is measured. The share measure captures women's representation among MSMEs, whereas the registration-count model is more sensitive to state size and registration intensity.

Discussion and Implications

The empirical evidence does not support the proposition that greater internet penetration automatically translates into greater women's entrepreneurial participation across Indian states. This finding is not inconsistent with the recent literature. Research on women entrepreneurs increasingly emphasises the distinction between access to technology and the capability to use technology productively. Digitalisation can provide an opportunity structure, but its economic value depends on complementary resources, skills, networks and institutional support.

The absence of a positive relationship in the present cross-section should therefore not be interpreted as evidence that digitalisation is irrelevant to women entrepreneurs. Instead, internet penetration is a relatively broad infrastructural measure. It does not reveal whether women entrepreneurs possess adequate digital literacy, whether they use e-

commerce platforms, whether they accept digital payments, whether they undertake digital marketing, or whether digital finance improves their access to working capital.

The high correlation between internet penetration and per-capita income also suggests that digitalisation cannot easily be separated from the broader development process. More developed states tend to possess better digital infrastructure, but the conversion of that infrastructure into women's entrepreneurship may depend on other institutional conditions.

The policy implication is that infrastructure expansion should be accompanied by capability-oriented interventions. Digital training for women entrepreneurs should move beyond basic computer literacy toward e-commerce, social-media marketing, online branding, cybersecurity, digital accounting, digital payments and platform-based market access. This is consistent with recent longitudinal evidence showing that sustained technology-enabled entrepreneurial growth requires learning, networks and complementary resources.

A second implication concerns finance. Digital financial services can potentially reduce transaction and information costs, but women entrepreneurs require access to credit, guarantees and financial literacy alongside digital infrastructure. The Ministry of MSME reports that women entrepreneurs receive enhanced guarantee coverage under the Credit Guarantee Scheme, while the RBI has reported that women-owned MSMEs represented 7.09% of outstanding MSME credit as of March 2023.

Third, policymakers should avoid evaluating digital entrepreneurship programmes only through connectivity indicators. More meaningful outcome measures would include women's online business formation, digital sales, e-commerce participation, digital-payment usage, enterprise survival and business growth.

For researchers, the results indicate that future empirical work should combine administrative MSME records with enterprise-level measures of actual digital adoption rather than relying exclusively on state-level internet penetration.

Limitations and Future Research

The principal limitation is the cross-sectional design. The analysis identifies association rather than causality and cannot establish whether digitalisation causes women to become entrepreneurs. Udyam data also measure formal registration and therefore do not capture all informal or unregistered women's enterprises. Internet penetration is an infrastructure indicator rather than a direct measure of entrepreneurial digital adoption.

The study also uses lagged state income and does not incorporate potentially important variables such as women's access to formal credit, digital financial transactions, education quality, urbanisation, social norms and entrepreneurial training.

Future research should construct a longer state-year panel when harmonised administrative data become available. Enterprise-level Udyam data linked with digital-payment usage, e-commerce adoption and credit outcomes would permit stronger causal designs, including instrumental-variable, difference-in-differences or dynamic panel approaches.

Conclusion

This study examined whether greater digitalisation is associated with greater women's entrepreneurial participation across Indian states. An explicit data audit showed that a long, fully comparable 2015–16 to 2024–25 state panel could not be constructed without making questionable assumptions about the changing definitions and coverage of administrative datasets. A conservative cross-sectional design was therefore adopted for 28 states.

The empirical evidence does not support the central hypothesis. Internet penetration was not positively and significantly associated with the share of women-owned MSMEs after controlling for female labour-force participation and state income. The robustness model based on new women-led MSME registrations likewise did not produce evidence of a positive digitalisation effect.

The principal conclusion is therefore not that digitalisation fails to matter for women's entrepreneurship. Rather, digital infrastructure by itself does not appear sufficient to explain interstate differences in women's entrepreneurial participation. Digital access must be converted into productive entrepreneurial capability through skills, finance, market access, networks and institutional support.

The findings reinforce a broader shift in the literature from a simple “digital access” perspective toward a digital capability and resource-complementarity perspective. For India, policies seeking to expand women's entrepreneurship through digitalisation should therefore move beyond connectivity targets and evaluate whether women are actually able to use digital technologies to create, formalise, finance, market and grow enterprises.

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