Fostering Participation in International Trade through Digitalization: A Case of India's Unorganized Sector MSMEs

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Abstract: The study investigates whether access to digital ways of conducting business can enhance the productivity of the unorganized sector MSMEs in India, and hence, foster their participation in international trade. The analysis is conducted using the National Sample Survey's 73rd round on unincorporated non-agricultural Indian enterprises for the year 2015-16, covering approximately 2,90,000 firms, and performing separate analysis for both manufacturing and services firms. The key findings are: First, digitalization has a positive impact on firm-level productivity, while controlling for firm-level characteristics. Second, the quantile regression analysis confirms the robust impact of digitalization across different levels of productivity. Third, the Probit Regression Model highlights the combined positive and significant impact of digitalization and productivity on the international trade participation of an unorganized sector MSME. These findings can serve as a motivation for accelerating the policy efforts towards better productivity and digital transformation of these firms, particularly for manufacturing MSMEs.

Keywords: Digitalization, Productivity, MSME, Exports

JEL Codes:D24, F61, J24, L86, L81,O33

1. Introduction

The transition into Industry 4.0 is characterized by the integration of digital technology into production processes, thereby enabling businesses to produce higher-quality goods at reduced costs and leading to a rise in productivity. Productivity, in turn, is a key source of competitiveness, particularly in the international markets (Antràs, 2003; Krugman, 1994; Melitz, 2003), fueled by digitalization that determines who participates in global markets and in which

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direction the profits flow (McKinsey, 2016). For developing nations like India, the shift towards technology-intensive production is occurring at a rather slow pace. India's production environment is dominated by Micro, Small, and Medium Enterprises, or MSMEs (across multiple stages) that constitute 99% of India's total businesses and contribute a massive 50% tothe country's total exports(Bhatia, 2022). However, they are still under-represented in the international market, and their potential to enter or compete in the global markets remains untapped as they are riddled with multiple issues related to a lack of digital and human infrastructure, inadequate access to credit, low profitability and lack of awareness.

Though there exists a great deal of evidence in the literature suggesting a positive link between digitalization and export performance, it is rather limited in the Indian context. For Indian organized sector MSMEs, only one study by Huria et al. (2022) finds that firms with higher investment in digital assets are not only more likely to enter the export market but also exhibit greater export intensity if they are already exporting. Clearly then, digitalization has ushered in new opportunities for India's organized MSME sector. A cause of concern, however, stems from the fact that over 97% of India's MSMEs belong to the unorganized sector (RBI, 2018), for which no such empirical evidence is found. A critical reason for this is the lack of firm-level data on MSMEs.[5]The unorganized sector MSMEs, being labor-intensive and employing around 80% of India's workforce, contribute around 50% to India's GDP (Maitra, 2020; Punia, 2020). It is also a key supplier of major commodities exported from India such as gems and jewelry, textiles, and chemicals (Mukherjee & Mukherjee, 2012; Vanamali, 2022).

Against this backdrop, our study focuses on the unorganized sector MSMEs, and tries to address the following objectives for both manufacturing and services sector firms: (i) Does digitalization have any productivity-enhancing effects for the unorganized sector MSME firms? (ii) How does the impact of digitalization vary across different levels of productivity (iii) What is the influence of digitalization when combined with higher productivity in facilitating export market entry for these firms? (iv) Is there any differential bearing of digitalization on productivity and export market entry of manufacturing vis-à-vis service sector firms? Given that the Indian manufacturing sector has been experiencing stagnancy in its growth for the past decade and a half, with more manufacturing sector trade rather than services trade getting

[5]Even though one can obtain sectoral level information in annual reports released by the Ministry of Micro, Small and Medium Enterprises (MSMEs), the same is inadequate to carry out an analysis at a microeconomic (firm) level, which is necessary to fulfil the objectives of this study.

impacted since the onset of the COVID-19 pandemic, addressing the last objective offers critical policy suggestions to revamp the country's overall production growth, and hence, exports.

The study is conducted using the National Sample Survey's (NSS) 73rd round on unincorporated non-agricultural enterprises, 2015-16, which is the first NSS round incorporating information on 290,000 MSME firms' digitalization and related aspects. Our paper makes four key contributions to the literature: First, it establishes an empirical relationship between digitalization and export market entry for India's unorganized sector MSMEs, which, to the best of the authors' knowledge, have never been attempted in the literature owing to the lack of adequate data. Second, analysis of a huge sample of unorganized sector MSMEs, comprising both manufacturing and service sector firms enables us to draw policy implications. Third, it validates the argument that greater digitalization in association with higher productivity is a pathway to entering international markets, thereby calling for a greater policy focus on the enhancement of firms' productivity. Finally, the robustness of the results is verified by using various methodologies such as Quantile regression and Probit regression.

The summary of the findings is as follows: First, digitalization enhances the productivity of the firm, while controlling for firm-level characteristics and this impact is consistent across different levels of productivity as shown by quantile regression analysis. Second, a Probit Regression model shows that digitalization, complemented with productivity, increases the predicted likelihood of a firm's participation in international trade. Third, the results are suggestive of the greater scope of gains from digitalization in manufacturing firms vis-à-vis services firms. Fourth, given these critical observations, the important question, however, remains – "Are the Indian unorganized sector MSMEs digitally equipped to sufficiently leverage the benefits from growing online commerce?". The empirical assessment highlights that only 5% percent of firms have access to basic digital infrastructure. While the international peers of India heading rapidly towards the adoption of digital practices (ET Online, 2021), the results obtained in this study calls for immediate policy attention before the new age of Industry 4.0 (and the upcoming 5.0 revolution) turned out a bane (rather than a boon) for the Indian economy.

The rest of the paper is organized as follows: section 2 discusses the extant literature on the impact of digitalization on firm productivity and exports. Section 3 puts forth the empirical strategy utilized in this study, while section 4 presents the results of the empirical exercises. The last section concludes the study and presents a few policy recommendations.

2. Literature Review

In line with the research questions outlined in the introductory section, the present section discusses two different yet interrelated impacts of digitalization on the productivity and export performance of the firm.

2.1 Productivity gains from digitalization

The importance of digitalization for businesses in the current era cannot be emphasized enough and now there exists growing evidence for the same. Digitalization enables firms to develop commercial relationships with both foreign and domestic firms, which, in turn, help firms improve their marketing strategies, technical knowledge, and response to competition (Bianchi &Mathews, 2016). It also allows for the production of quicker, more flexible, and efficient procedures as well as higher-quality output at lower costs. As a result, manufacturing productivity and innovation capabilities grow and improve market competitiveness (Oesterreich & Teuteberg, 2016; Rüßmann et al., 2015).Digital capability of a firm also has a positive impact on product sophistication (Banga, 2019). In a recent study by Kharlamov and Parry (2021), it has also been posited that digitalization and servitization together improve customer experience and sustain competitiveness, thereby contributing to firm profitability and productivity.

This crucial nexus between digitalization and productivity has been observed in a large body of literature based on different countries, covering different periods, using various methodologies, and considering different measures of productivity and digital technology (see Table 1).The majority of the studies find a positive association between the two (Akerman et al., 2015; Andrews et al., 2018; Bartel et al., 2007,Borowiecki et al., 2021; Cette et al., 2021; DeStefano et al., 2019;Ferschli et al., 2021; Gal et al., 2019; Grimes et al., 2012;Motohashi, 2008; Tamegawa et al., 2014), except for the study by Acemoglu et al. (2014) which found no effect of IT intensity on manufacturing productivity except in the computer-producing industry by using US firm-level data from 1977 to 2007 and another study by Bartelsman et al. (2017) finding no significant effect of internet access on intra-firm productivity, but a positive effect at the aggregate level, which could be due to reallocation (i.e., the growing size of more productive firms as compared to less productive firms), firm entry and exit, or spillovers across firms.

Table 1: Select studies linking digitalization and productivity

Source	Measure of productivity	Measure of digitalization	Region	Period
Global				
Bartel et al. (2007)	Production time	IT-based improvements in Computer and numerically controlled machines	The United States of America	1999-2003
Motohashi (2008)	Value-added	IT controlled machinery stock	China	1995-2002
Grimes et al. (2012)	Value-added per worker	Broadband availability, mobile phone coverage, etc.	New Zealand	2006
Acemoglu et al., (2014);	log ratio of gross output to payroll employment	Ratio of industry computer (IT) expenditures to total capital expenditures.	United States	1980–2009
Tamegawa et al. (2014)	Total factor productivity	Cloud computing	Japan	2012
Akerman et al. (2015)	Value Added	Broadband adoption	Norway	2001-2007
Bartelsman et al. (2017)	Value-added	The proportion of broadband internet-connected employees has been used to reflect the ICT intensity of firms	Europe	2002-2010
Andrews et al. (2018)	Value-added per worker, Multifactor productivity	Complementarity between ICT, Intangible capital, digitalization	24 OECD countries	1997- 2014
Gal et al. (2019)	Multi-factor productivity	High-speed broadband internet connection, cloud computing, etc.	19 EU countries and Turkey	2010-15
DeStefano et al. (2019)	Sales per worker	Cloud technology	United Kingdom	2008, 2013, 2015
Cette et al. (2021)	Value-added	Cloud and big data adoption	France	2018
Borowiecki et al., 2021; et al. (2021)	Value-added per worker	Expenditure on Research and Development per worker, Investment in Information and Communication technology per worker	Netherlands	2012-17
Ferschli et al. (2021)	Value-added per hour worked	Investments in ICT, Research & Development (R&D)	Germany	2000-2015
Indian				

Joseph and Abraham (2007)	Partial and total factor productivity	IT investment	India	1998-99 to 2001-02
Commander et al. (2011)	Value-added	Information and Communication Technology (ICT) capital as a % of sales	Brazil, India	1998-2003
Sharma and Singh (2013)	Value Added	IT investment, IT capital stock	India	2003-2007

Source: Authors' compilation

In the Indian context, Joseph and Abraham (2007) provide evidence for a positive association between IT investment and productivity/ productivity growth among manufacturing firms using Center of Statistics Office (CSO) data from 1998-99 to 2001-02.Using a different source (India's Annual Survey of Industries), Sharma and Singh (2013) also present similar findings for manufacturing firms for the period 2003-2007.Commander et al. (2011) present econometric evidence for a strong association between ICT capital and productivity in India and Brazil, even after controlling for firm-specific fixed-effects. Considering recent time periods, only a few qualitative studies can be found covering the Issue in the Indian context. Kumar (2019) states that digitalization brings transparency, accuracy and increased productivity, although it is at a nascent stage in India currently. Ikrama & Ahmed (2018) conduct a primary survey of 12 firms to find that digitalization of Indian MSMEs can improve their productivity, profitability and sustainability. The key observation from the literature is that the evidence for the effect of digitalization on the Indian MSMEs' productivity remains largely uninvestigated.

2.2 Digitalization and export performance

In the context of Small and Medium Enterprises operating in Eastern Europe and Asia in 1999, Clarke (2008) establishes that firms that have access to the internet are more likely to export. Portugal-Perez and Wilson (2012) show that digital infrastructure becomes relatively important as a developing country becomes richer when it comes to its export performance. Several firm-level studies have also explored the impact of digitalization on exports in the context of various countries. A study by Fernandes et al. (2019) encompassing Chinese manufacturing firms finds that digitalization (in the form of internet access) increases their exports due to a visible virtual presence and reduction in communication costs. Digital practices were found to have a positive and significant impact on the service exports of the ASEAN 5[6] countries (Tee et al., 2020). Trașcă et al. (2019) find evidence in favour of the integration of digital technology into business activity and improvement in exports at the SME level for central and eastern European countries. In another study, Atasoy (2021) finds in his study of 61 countries that exports get more sophisticated as the digitalization of a firm increases. A recent study by Gopalan et al. (2022), based on firms across 52 countries, shows that digitalization increases the likelihood of a firm to

[6] ASEAN 5 countries comprise ofIndonesia, Malaysia, the Philippines, Singapore, and Thailand

participate in Global Value Chains (GVCs) and these benefits even extend to SMEs and small agglomerates through productivity gains.

While there exists growing evidence regarding the importance of digitalization in literature, rather limited studies have been conducted in the Indian context specifically. For instance, one of the foremost assessments was done by Lal (2004) who illustrates the positive impact of digitalization on the export performance of the Indian textile industry. He attributes this to the positive role played by digital technologies in facilitating greater flexibility in garment designs. Another study by Bhat (2015) provides evidence for the same for the Indian pharmaceutical industry. Gautam (2017) finds, on an aggregate level, that Indian firms utilizing e-commerce are 21.8% more likely to be exporters and their intensity of exports is likely to increase by 7.9 percent. A recent study by Banga and Banga (2020) shows that the country is losing its export competitiveness in some of its key traditional export sectors due to the lower amount of value added by digital services and provide empirical evidence for the positive role of digitalization in improving the export intensity of Indian manufacturing firms.

As regards the Indian MSMEs, Mohapatra (2020) finds that the micro and small industry groups have a higher export performance, vis-à-vis medium, and large industry groups. This shows that India can increase its exports by focusing on the MSME sector more since they face greater constraints, vis-à-vis the large firms when it comes to the international market, especially so for the adoption of digital practices. Yet, barring Huria et al. (2022), the literature remains devoid of any significant empirical attempts concerning Indian MSMEs' digitalization-led improvements in export performance. Further, there is no study that highlights that the digitalization affects export performance of the firm through the channel of productivity.

3. Empirical Strategy

3.1 Data and Variables Description

The empirical assessment of the impact of digitalization on productivity and international trade participation is carried out using data from the latest NSS 73rd round survey on Unincorporated Non-Agricultural Enterprises (Excluding Construction) for the period July 2015-June 2016. The non-MSME firms have been filtered out based on the MSME categorization provided by the database in terms of the investment in plant and machinery for manufacturing firms and investment in plant and equipment for services firms using the definition provided in the Micro,

Small and Medium Enterprises Development (MSMED, Act 2006). The final sample consists of a cross-section of 29,019 unorganized sector MSMEs.

Digitalization as a term is subject to the rapidly occurring advancements in technology. Hence, we capture its meaning to the best extent possible given the information available in the NSS dataset. Primarily, we utilize two variables of binary nature, 'access to computer' and 'access to internet' and a continuous variable on 'ICT infrastructure owned' to carry out the required assessment. Next, whether a firm participates in international trade can be gauged by the information on the firm's Directorate General of Foreign Trade (DGFT) registration status.[7] Other variables used in the analysis such as GVA per worker, the proportion of skilled workers, total capital intensity, total fixed assets, age, location, growth status, type of ownership, registration status, challenges faced, and government assistance received are encapsulated in Table 2.

[7]Registration with DGFT is an essential requirement for an Indian firm to indulge in importing/exporting activities.

Table 2: Construction of variables

Variable	Description	Expected sign
GVA per worker	Ratio of real output (i.e., gross value added) by the total number of workers employed by the enterprises and indicates the workers' productivity. GVA per worker= GVA/ Total workers	Dependent Variable
DGFT registration	1 if the firm is registered with the Directorate General of Foreign Trade (DGFT), 0 otherwise	Dependent variable
The proportion of skilled workers	The share of skilled workers in the total number of people employed by the firm	+
ICT per skilled worker	Ratio of the stock of ICT infrastructure owned by the firm and the number of skilled workers employed	+
Total Capital intensity (excluding ICT infrastructure)	The amount of total capital available (excluding the stock of ICT infrastructure) per worker. Capital Intensity= Investment in Plant and Machinery/Total workers	+
Total Fixed Assets	Sum of fixed assets owned by the firm	+/-
Age of the firm	Year of the survey – the initial year of operation	+/-
Location of the enterprise dummy	1 if within household premises, 0 otherwise	-
Status of the enterprise in the last three years dummy	1 if expanding, 0 otherwise	+
Type of ownership dummy	1 if proprietary (male), 0 otherwise	+
A social group of the owner/major partner	1 if the owner/major partner belongs to the Scheduled Tribes, 0 otherwise	-
Registration dummy	1 if registered, 0 otherwise	+
Challenges dummy	1 if the enterprise faced any problem in its operation during the last 365 days, 0 otherwise	-
Government assistance	1 if the enterprise received government assistance during the last three years, 0 otherwise.	+
Computer dummy	1 if the firm made use of a computer during the last 365 days, 0 otherwise	+
Internet dummy	1 if the firm made use of the internet during the last 365 days, 0 otherwise	+

Source: Authors' computation based on the NSS 73rd round

The summary statistics of variables utilized for the analyses are given in Table 3.

Table 3: Summary statistics

Variable	Mean	Standard Deviation	Min	Max
GVA per worker	9.14	13.53	-871.6	1847.1
DGFT registration	$0.8*10^{-5}$-	0.01	0	1
The proportion of skilled workers	0.63	0.44	0	1
ICT per skilled worker	5.1	15.53	0	1251.66
Total Capital intensity (excluding ICT infrastructure)	721.44	9388.82	0	2165479
Total Fixed Assets	532924.9	7683893	0	2170000000
Age of the firm	10.27	8.61	0	193
Location of the enterprise dummy	0.30	0.46	0	1
Status of the enterprise in the last three years dummy	0.40	0.49	0	1
Type of ownership dummy	0.87	0.33	0	1
Social group of the owner/major partner	0.06	0.23	0	1
Registration dummy	0.45	0.50	0	1
Challenges dummy	0.38	0.49	0	1
Government assistance	0.02	0.13	0	1
Computer dummy	.105	0.31	0	1
Internet dummy	.084	0.28	0	1

Source: Authors' computation based on the NSS 73rd round

The sample of firms constituting our dataset exhibit varying levels of productivity, firm size (total fixed assets), and capital intensity, among other features, as observed from the table. Also, a lesser proportion of firms have access to the internet in comparison to a computer.

3.2 Preliminary Analysis

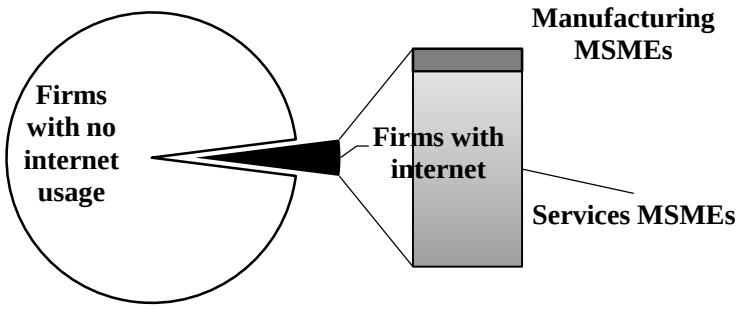
The preliminary analysis seeks to provide an overview of the status of digitalization of the Indian unorganized sector MSMEs and its nexus with the productivity level of the firm.

The digitalization levels of unorganized sector MSMEs

The digitalization level of Indian unorganized MSMEs is quite low asonly 5% and 4% of the total firms had access to computer and internet, respectively (see Figure 1). This may indicate issues related tothe availability of requisite skills, resources, and awareness. Further, the digitalization level amongst manufacturing MSMEs is comparatively lower than their service counterparts – a point also stressed by Huria et al. (2022) in the context of India. This implies

that the manufacturing sector holds greater potential for digitalization as will be established empirically in coming empirical exercises.

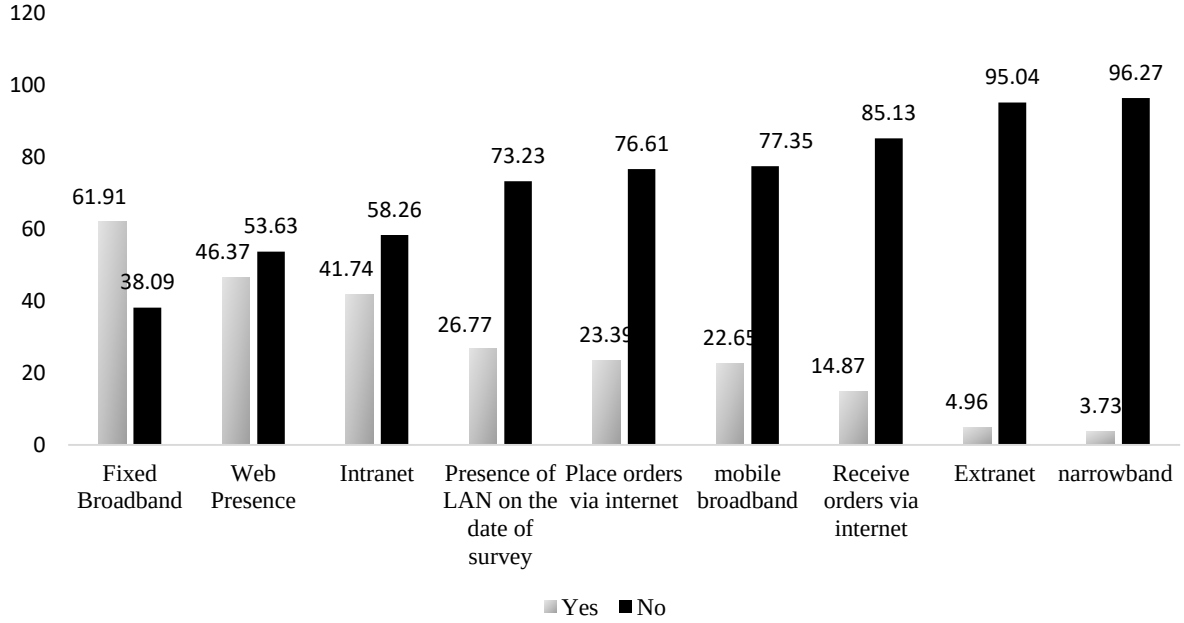
Figure 1: Proportion of MSME firms that had access to the internet in the last 365 days



Source: Authors' calculations based on NSS 73rd round

Among various digital infrastructures utilized by the firms(figure 2), there is extremely limited or no web presence,which exhibitstheir strikingly low participation levels in e-commerce – a medium of shopping that has become extremely popular among consumers in recent years. Consequently, consumer demand is being captured by the first movers.

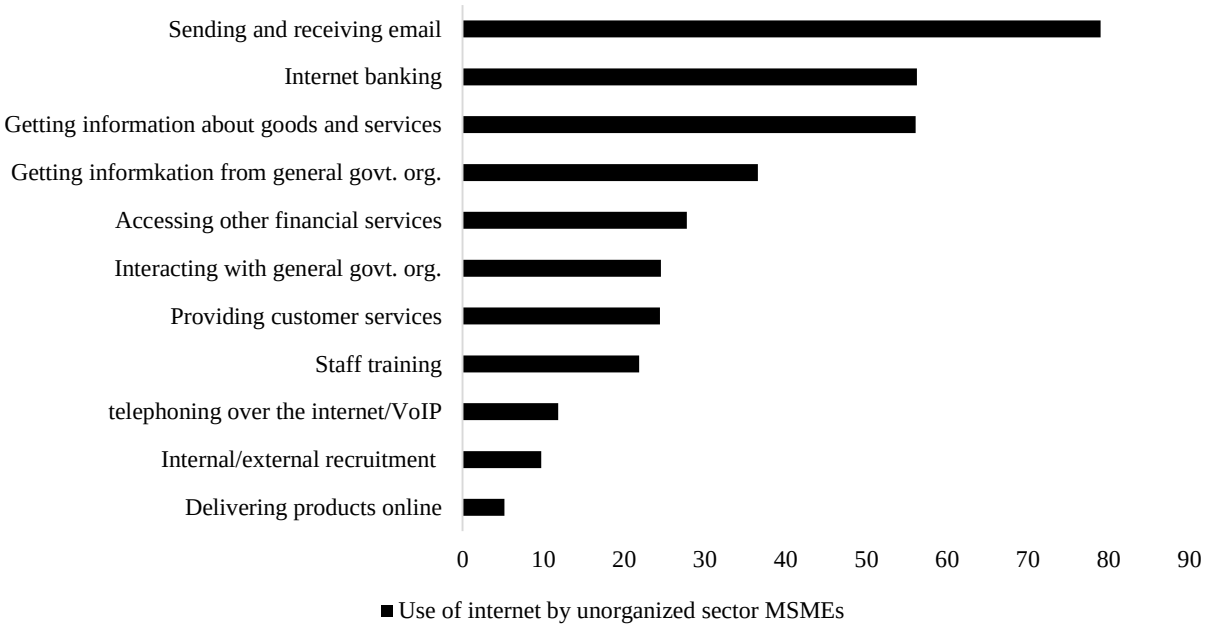
Figure 2: Percentage of MSMEs utilizing various Digital Infrastructure



Source: Authors' calculations based on NSS 73rdround

As concerns digital practices, Figure 3 shows that only 5% of firms deploy internet services for delivering products online. It is important to consider that MSMEs employ a large proportion of unskilled and semi-skilled workers that often come from not-so-well-off backgrounds with limited access to digital assets and a lack of training and skills. Hence, their exposure to digital practices remains limited.

Figure 3: Use of the internet by unorganized sector MSMEs



Source: Authors' calculations based on NSS 73rd round

To summarize, it is observed that only a small proportion of the unorganized MSMEs indulged in any sort of digital activities.

Nexus between Digitalization and Gross Value Added per worker(GVA)

The roadblocks to the digitalization of MSMEs such as lack of skills and infrastructure, continue to prevail due to a lack of finances and poor profitability, once again pointing toward the weak fundamentals of firm performance in MSMEs. A key parameter reflecting the performance of a firm is its productivity (or GVA per worker). Therefore, as a preliminary exploration of the link between digitalization and productivity, the empirical assessment begins by looking at the impact of computer and/or internet usage on a firm's Gross Value Added per worker (GVA per worker) or productivity using an independent samples t-test. Here, the null hypothesis (H_o) states that the GVA per worker of firms that used a computer in the last 365 days (GVA_c) is equal to the mean

GVA per worker of the firms that did not (GVA_{nc}). The alternate, however, proposes that firms with access to computer exhibit higher GVA per worker.

H_o: $GVA_c = GVA_{nc}$

H_a: $GVA_c > GVA_{nc}$

The independent samples t-test hypothesis produces a t value of 85.02 and rejects H_o at a 1% significance level (Table 4), implying a significantly higher productivity (GVA per worker) for firms that used computers in the past year.

Table 4: t-Test results for the difference in GVA per worker of firms with and without access to a computer

Variable	Obs.	Average export intensity	SE	Standard Deviation	95% Confidence Interval		T stat for H_0	Significantly different means?
Access	30633	15.27	0.16	28.09	14.96	15.59	85.02***	Yes
No access	256787	8.41	0.02	10.28	8.37	8.45		

Source: Authors' computation based on the NSS 73rd round

On similar lines, Table 5 compares the mean GVA per worker of firms that used the internet (GVA_i) in the past 365 days with the mean GVA per worker of firms that did not (GVA_{ni}). The null and alternate hypotheses are mentioned below, followed by Table 5 encompassing the t-test results.

H_o: $GVA_i = GVA_{ni}$

H_a: $GVA_i > GVA_{ni}$

Table 5: t-Test results for the difference in GVA per worker of firms with and without access to the internet

Variable	Obs.	Average export intensity	SE	Standard Deviation	95% Confidence Interval		T stat for H_0	Significantly different means?
Access	24579	16.14	0.19	30.58	15.76	16.53	85.99***	Yes
No access	262841	8.48	0.02	10.37	8.44	8.52		

Source: Authors' computation based on the NSS 73rd round

In this case, a t value of 85.99 has been obtained from the independent samples t-test hypothesis, thereby rejecting H_o at a 1% significance level. Therefore, it can be concluded that firms using the internet demonstrate a significantly higher level of Gross Value Addition per worker as compared to firms not using the internet.

3.3 Model Specification for Regression Analysis

It has been seen that firms with greater levels of digitalization display higher productivity. The next set of analyses will explore this relationship further by controlling for other factors affecting productivity through multivariate regression, conducted for the entire sample as well as separately for manufacturing and services sector firms. The general framework of the model can be represented as:

GVA per worker= $\boldsymbol{\alpha}$ + $\boldsymbol{\beta_1}$Internet (dummy) x Computer(dummy) x Proportion of Skilled Workers or ICT per skilled worker + $\boldsymbol{\beta_2}$Capital Intensity (excluding ICT infrastructure) +$\boldsymbol{\beta_3}$Registration+ $\boldsymbol{\beta_4}$Growth Status + $\boldsymbol{\beta_5}$Challenges+$\boldsymbol{\beta_6}$Government Assistance+$\boldsymbol{\beta_7}$Ownership +$\boldsymbol{\beta_8}$Location + $\boldsymbol{\beta_9}$Social Group + $\boldsymbol{\beta_{10}}$Age of the firm + ϵ_{it} (1)

The model captures digitalization through the interaction of three-component variables: *Computer (dummy), Internet (dummy),* and *Proportion of Skilled Workers*. The third variable in the interaction term helps account for the complementarities between different tools of digitalization and the capabilities of human capital (Andrews, 2018). In another iteration, *ICT infrastructure owned per skilled worker* serves as an alternative measure of digitalization with the same model specification. Details of other explanatory variables specified in equation (1) have been incorporated in Table 2.

As a robustness check, we also conduct a quantile regression analysis on model (1). It is a useful tool to describe the effects over the entire distribution of observed outcomes (Koenker, 2005). Unlike regular linear regression which uses the method of ordinary least squares (OLS) to compute the conditional mean of the target across different values of the features, quantile regression estimates the conditional median of the target (Dye, 2020).The analysis that follows will allow one to see if the findings are consistent across 10^{th}, 25th, 50th, 75th and 90^{th} quantiles. Taking a similar structure to model (1), the quantile regression model equation for the τ^{th} quantile is

$\mathbf{Q_\tau}$(GVA per worker)= $\boldsymbol{\alpha}(\tau)$ + $\boldsymbol{\beta_1(\tau)}$Internet (dummy) x Computer(dummy) x Proportion of Skilled Workers or ICT per skilled worker + **…….**+ $\boldsymbol{\beta_{10}(\tau)}$Age of the firm + $\epsilon_{it}(\tau)$ (2)

The regression coefficients are no longer constants, but a function of τ.

Next, it is proposed that the Directorate General of Foreign Trade (DGFT) registration, reflecting participation in international trade, can be promoted if the firm's productivity is complemented by digitalization. Since the DGFT variable is of binary nature, a probit regression model is utilized. The general framework of the model is represented below:

DGFT= $\boldsymbol{\alpha}$ + $\boldsymbol{\beta_1}$Internet(dummy) x Computer(dummy) x GVA per worker + $\boldsymbol{\beta_2}$Proportion of skilled workers+$\boldsymbol{\beta_3}$Size(total fixed Assets) + $\boldsymbol{\beta_4}$Age+ $\boldsymbol{\beta_5}$Challengesfaced and firm's growth status(dummy)+$\boldsymbol{\beta_6}$Government assistance+ $\boldsymbol{\beta_7}$Ownership + ϵ_{it} (3)

The impact of digitalization is assessed by taking the interaction of the *internet dummy, computer dummy,* and *workers' productivity*. It must be noted that since a relationship between *GVA per worker* and the 3-variable interaction term for digitalization is already explored in equation (1), considering both the variables as explanatory variables in equation (3) would result in multicollinearity. Hence, the second model takes a different measure of digitalization by interacting workers' productivity as captured by *GVA per worker* with *internet(dummy)* and *computer (dummy)*. This also allows one to check for any existing complementarity between productivity and digitalization together to determine DGFT registration. Additionally, the *proportion of skilled workers* has been taken as a separate explanatory variable to account for its effects on a firm's decision. The variable '*If the firm was expanding and did not face any challenges'* is an interaction of dummy variables of challenges faced and the status of the firm in the last three years (see Table 2) to control for firm performance. Other variables have their usual meaning. The results of the empirical exercises are presented in section 4 of the paper.

4. Estimation Results

4.1 Impact of Digitalization on Productivity

Table 6 presents the results of the impact of digitalization on the productivity of MSME firms. The assessment has been carried out for all unorganized sector MSMEs, followed by separate analyses for manufacturing and services sectors, keeping in mind the differences in the nature of the two sectors. It reveals that firms that have access to both internet and computer complemented by a higher proportion of skilled workers are shown to have a high and significant increase in their workers' productivity, vis-à-vis those that have access to either computer or internet. The results are in line with the findings of Cette et al. (2021), Nurmilaakso (2009), and

Gal et al. (2019). On the other hand, the firms that have no access to computer and the internet experiences the lowest (or no) increase in their workers' productivity levels. This is a novel contribution of this study, as it presents empirical evidence for different levels of the basic digital infrastructure of the firm in terms of access to computers and the internet. A key observation to make here is that the magnitude of the impact of digitalization on productivity is greater for the manufacturing sector firms than for the services sector firms. This outcome is consistent with the findings of Gal et al. (2019) and is reflective of the immense potential that the unorganized sector manufacturing MSMEs possess for digital transformation, and hence, possibly improve productivity. The second iteration of the same model suggests that firms that have access to a high level of ICT infrastructure per skilled worker, were seen to exhibit higher productivity levels, vis-à-vis those with lower ICT intensity. This result, while developing the robustness of our assessment, clearly portrays the significance of being digitalized in ensuring higher productivity of firms belonging to the unorganized MSME sector. This is because, as is well known by now, digitalization serves as a catalyst in speeding up the production process(es), making them smoother and more adaptable, ultimately resulting in enhanced productivity and innovation capabilities (Vona et al., 2019). Once again, in accordance with the previous iteration, the coefficient obtained for the manufacturing firms is greater than those for the services firms.

Among covariates, a positive and significant coefficient of capital intensity indicates that firms with more machinery, equipment, land, etc., per worker display higher productivity, in line with Dandapat (2021). Further, with an exception in the case of manufacturing firms, younger firms are more productive than the older ones. This is because the new firms make more intensive use of ICT, digital tools, and innovation OECD (2021). Other control factors such as registration, gender, social group, and government assistance are also important with respect to a firm's productivity. If the firm is registered under a specific act or authority (Factories Act excluded), it is shown to display a higher level of productivity (Dandapat, 2021; Sharma, 2021). The possible reason for this could be the benefits associated with registrations. For instance, the Shop and Establishment act allows one to open a current business account, and avail schemes of the State DIC (District Industries Centre) Department. Consequently, these firms are likely to be better off than the unregistered ones. The results indicate gender disparities as GVA per worker is likely to be higher for enterprises that have male ownership. A report by Mastercard states that certain financial, social, and technical barriers make the entrepreneurship environment

unfavorable for Indian women (Kumar & Dutt, 2020).Further, if the business is confined to the house of its owner, it displays less productivity. This reflects that the business might be in its nascent stage and is unable to reach its full productive capacity. From the social aspect, a firm owned by an individual belonging to the ST category has a lower GVA per worker. The study by Iyer et al. (2013) also found that ST-owned businesses are likely to be less well-off due to the impact of social discrimination. Finally, the firms that have faced problems in operation in the last 365 days are likely to have lower GVA per worker. Not surprisingly, even though government assistance (in form of credit, subsidies, skill development, etc.) implies greater productivity for the collective sample and service sector firms, it is not so for the manufacturing sector firms. Apart from existing loopholes in government policies and schemes implementation, this could be attributed to their inability to benefit from such schemes due to unawareness. Another reason could be the considerably lower public expenditure on research and development (which is important in boosting productivity levels) in India relative to other comparative economies {0.65% of Indian GDP as against the world average of 2.2% in the year 2019 (World Bank, 2021)}. Therefore, it seems plausible to obtain such results.

Table 6: Regression results for the impact of digitalization on productivity (GVA per worker)

VARIABLES	All firms		Manufacturing		Services	
	(1)	(2)	(3)	(4)	(5)	(6)
Access to internet and computer-supported by skilled workers	4.2949***		7.517***		3.864***	
	(0.4075)		(1.405)		(0.415)	
Access to internet supported by skilled workers	3.9872***		6.655***		3.578**	
	(1.3851)		(1.138)		(1.577)	
Access to computer supported by skilled workers	2.4523***		4.091***		2.272***	
	(0.6658)		(1.237)		(0.730)	
No access to internet and computer	-0.6594***		1.198***		-0.719***	
	(0.1635)		(0.288)		(0.187)	
ICT infrastructure owned by the firm per skilled worker		0.0853***		0.357***		0.0763***
		(0.0107)		(0.0921)		(0.0100)
Total capital intensity (excluding ICT infrastructure)	0.0004***	0.0004***	0.000600***	0.000694***	0.000419***	0.000364***
	(0.0001)	(0.0001)	(0.000204)	(0.000235)	(0.000113)	(0.000106)
Age of the firm	0.0325***	0.0331***	-0.0184**	-0.0143*	0.0568***	0.0617***
	(0.0079)	(0.0094)	(0.00813)	(0.00803)	(0.0101)	(0.0135)
If the firm received government assistance	1.2609	0.9452	-0.709*	-0.779**	2.960**	3.336***
	(0.9314)	(0.6725)	(0.377)	(0.367)	(1.507)	(1.197)
If the firm faced challenges	-1.0292***	-0.8576***	-0.739***	-0.534***	-1.077***	-1.038***
	(0.1303)	(0.1335)	(0.150)	(0.146)	(0.163)	(0.183)
If the growth status of the firm is expanding	0.9765***	1.0414***	1.017***	0.862***	0.861***	1.005***
	(0.1356)	(0.1514)	(0.176)	(0.185)	(0.167)	(0.197)
If the firm is registered	3.7559***	3.5899***	2.616***	2.481***	3.831***	3.688***
	(0.1574)	(0.1602)	(0.237)	(0.242)	(0.181)	(0.192)
If the firm is owned by a male proprietor	2.4046***	2.6016***	3.130***	3.120***	1.251***	1.357***
	(0.1531)	(0.1440)	(0.147)	(0.154)	(0.248)	(0.247)
If the location of the enterprise is within the household	-2.1427***	-2.1919***	-2.537***	-2.762***	-1.611***	-1.463***
		(0.1482)	(0.211)	(0.181)	(0.171)	(0.209)
If the owner belongs to the ST category		-1.9892***	-2.470***	-1.383***	-2.460***	-2.250***
		(0.2378)	(0.730)	(0.321)	(0.253)	(0.297)
Constant	6.2535***	5.4513***	4.441***	5.154***	7.239***	6.408***
	(0.2285)	(0.1811)	(0.348)	(0.243)	(0.303)	(0.283)
Observations	171,924	127,784	45,831	41,265	126,093	86,519
R-squared	0.09	0.11	0.25	0.25	0.07	0.07

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10. Digitalization variable incorporates access to computer/internet in the last 365 days which can impact productivity today, however, today's productivity cannot impact the access to computer/internet in the last 365 days. Therefore, the model is free from the issue of endogeneity.

Source: Authors' calculations based on the NSS 73rd round

4.2 Robustness Check: Quantile Regression Model

As a robustness check, Quantile regression has been conducted for all firms' samples to check whether the magnitude of the impact of digitalization varies across different scales of productivity of the firm. The analysis makes use of five quantiles 0.10, 0.25, 0.50, 0.75, and 0.90. Table7 shows a consistently significant positive effect of digitalization across all levels of productivity, reinforcing its importance once again. The effect of digitalization is the strongest in upper quantiles (0.75 and 0.90), i.e., for the higher GVA firms. Results from the quantile regression supplement the previous findings for most of the control variables and are also statistically significant at the 1% level.

Table 7: Quantile regression results for the impact of digitalization on productivity (GVA per worker)

VARIABLES	Q10	Q25	Q50	Q75	Q90
	(1)	(2)	(3)	(4)	(5)
Access to internet and computer-supported by skilled workers	1.7039***	2.4242***	3.1336***	4.3896***	5.4374***
	(0.2005)	(0.2401)	(0.2948)	(0.4913)	(0.9004)
Access to internet supported by skilled workers	1.9760***	2.7405***	3.7158***	3.3442***	6.4695*
	(0.0969)	(0.6597)	(0.2087)	(0.1964)	(3.3689)
Access to internet supported by skilled workers	0.9647***	1.2499***	1.5260***	2.7391**	5.3200***
	(0.3428)	(0.1019)	(0.4345)	(1.1395)	(0.5495)
No access to internet and computer	0.3748***	0.2775***	0.1234	-0.2695*	-1.4327***
	(0.0814)	(0.0870)	(0.1087)	(0.1626)	(0.3399)
Total capital intensity (excluding ICT infrastructure)	0.0002**	0.0006***	0.0010***	0.0018***	0.0039***
	(0.0001)	(0.0002)	(0.0000)	(0.0003)	(0.0009)
Age of the firm	0.0008	0.0015	0.0100*	0.0226**	0.0326**
	(0.0043)	(0.0031)	(0.0053)	(0.0098)	(0.0163)
If the firm received government assistance	0.0635	0.0901	0.3891	0.4368	1.8459
	(0.2164)	(0.6043)	(0.3148)	(0.2712)	(2.2972)
If the firm faced challenges	-0.4368***	-0.5350***	-0.7653***	-1.1420***	-1.5940***
	(0.0665)	(0.0627)	(0.0820)	(0.1390)	(0.2427)
If the growth status of the firm is expanding	0.3622***	0.6203***	0.8928***	1.1870***	1.2882***
	(0.0691)	(0.0713)	(0.0965)	(0.1574)	(0.2552)
If the firm is registered	1.3865***	1.7404***	2.5357***	3.7768***	5.3565***
	(0.0854)	(0.0784)	(0.1070)	(0.1729)	(0.3578)
If the firm is owned by a male proprietor	0.9629***	1.6179***	2.4657***	3.4762***	4.6083***
	(0.0677)	(0.0659)	(0.0897)	(0.1739)	(0.2806)
If the location of the enterprise is within the household	-1.0763***	-1.5844***	-2.1646***	-2.6749***	-2.7387***
	(0.0755)	(0.0698)	(0.0989)	(0.1552)	(0.2452)
If the owner belongs to the ST category	-1.4192***	-1.3858***	-1.7389***	-2.2064***	-3.3657***
	(0.2097)	(0.1737)	(0.3074)	(0.4698)	(0.9567)
Constant	1.5268***	2.6944***	4.4893***	7.1225***	11.0224***
	(0.1056)	(0.1089)	(0.1434)	(0.2355)	(0.4232)
Observations	171,924	171,924	171,924	171,924	171,924

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10

Source: Authors' calculations based on NSS 73rd round

4.3 Probit Regression Model: Impact of digitalization and productivity on export market entry

Empirical evidence in favour of digitalization as a driver of productivity brings us to our next objective, i.e., whether digitalization combined with productivity can encourage greater participation of unorganized sector MSMEs. Once again, similar to Table 6, separate analyses for the three groups of firms have been conducted in Table 8. Across all firms, it is observed that access to the internet and computer supported by productive workers implies a higher predicted likelihood of an unorganized sector MSME's registration into DGFT. Once again, due to the inferior levels of digitalization in manufacturing firms, they exhibit a greater scope for gains from digitalization than the services firms, as shown by their respective coefficients[8]. In line with the same, Huria et al. (2022) utilized data from OECD's Trade in Value Added database to show that the contribution of digital services is meager for the Indian manufacturing sector exports, clearly reflecting that the sector holds greater potential because it has been unable to utilize digitalization to its advantage in the past. This argument serves as a rationale to lay greater emphasis on the manufacturing sector while formulating policies.

Next, having access to a computer and the internet provides exposure to the benefits of registration. In addition, with the registration procedure now made online, it seems plausible that registration is more likely to occur if the firm has access to a computer and the internet. These findings are in line with the results of Banga & Banga (2020), Bhat (2015), Gautam (2017), Gopalan et al., (2022) and Huria et al. (2022), who show that digitalization is positively related to export performance/ GVC integration of firms. A negative coefficient for the firms without internet and computer access, confirms the same. Grima et al. (2004) emphasize the importance of productivity for a firm's export performance. However, to the best of the authors' knowledge, this is the first study to consider the interaction of productivity and digitalization.

Among covariates, the dummy variable indicating whether the firm received government assistance or not turns out to be a significant factor in influencing an unorganized sector's MSME's decision to participate in global trade (Jotwani & Singh, 2016). It is important to contrast this result with the results in Table 6 where the coefficient for the same variable had turned out to be negative. This seems plausible from the fact that there are several government

[8]Even though the number of observations varies between manufacturing and services firms, our results are indicative of the differential impact between the two.

schemes and measures that have focused on trade promotion in the last decade (Export Promotion Capital Goods (EPCG) scheme, Duty-Free Import Authorization (DFIA) Scheme, Remission of Duties or Taxes on Export Product, Interest Equalization Scheme (IES), etc.), while a very few targeted productivity gains. For instance, technology centers, MSME development centers, and big tool rooms have been set up only after 2019 to address productivity issues (Chakraborty, 2019).

Further, we find that larger firms are more likely to be registered with the DGFT, implying that the size of the firm plays an important role in determining its participation in international trade (Banga & Banga, 2020; Bekteshi, 2020; Ilmakunnas & Nurmi, 2010; Ruzzier & Ruzzier, 2015; Srinivasan & Archana, 2011). This is because larger firms have greater resource availability. Next, it is seen for the manufacturing sector that at least in the case of younger firms, there is a higher predicted likelihood of being engaged in imports and/or exports. This is possibly due to greater awareness and proactiveness in adapting to changes in production methods(Upward et al., 2013).

Table 8: Probit Regression Model Results: Factors affecting the entry of firms into the Export Market (DGFT Registration)

VARIABLES	All firms		Manufacturing		Services	
	(1)	(2)	(3)	(4)	(5)	(6)
Productive workers with access to internet and computer	0.00326***		0.0109***		0.0032***	
	(0.000962)		(0.0039)		(0.0009)	
Productive workers without access to internet and computer		-0.0055***		-0.0165*		-0.0055***
		(0.0014)		(0.0093)		(0.0014)
Proportion of skilled workers	0.0980	0.1008	0.1618	0.1428	0.0106	0.0174
	(0.1613)	(0.1620)	(0.2992)	(0.2881)	(0.1861)	(0.1878)
Size (Total Fixed Assets)	0.00281**	0.0037***	0.0080*	0.0094***	0.0017	0.0035***
	(0.00114)	(0.0008)	(0.0048)	(0.0033)	(0.0021)	(0.0011)
Age of the firm	-0.0127	-0.0119	-0.0776*	-0.0721*	0.0031	0.0036
	(0.0109)	(0.0107)	(0.0426)	(0.0413)	(0.0050)	(0.0048)
If the firm received government assistance	0.4760*	0.5034**	0.5929*	0.5833*	0.4198	0.4935
	(0.2520)	(0.2339)	(0.3384)	(0.3383)	(0.3677)	(0.3008)
If the firm was expanding and did not face any challenges	0.2064	0.2410*	0.0930	0.1507	0.3229**	0.3658**
	(0.1393)	(0.1428)	(0.2004)	(0.2013)	(0.1643)	(0.1706)
If the firm is owned by a male proprietor	-0.407**	-0.4092***	-0.1018	-0.1048	-0.5616***	-0.5666***
	(0.1610)	(0.1572)	(0.2559)	(0.2597)	(0.1897)	(0.1874)
Location	0.1704	0.1578	-[9]	-	0.4728**	0.4601**
	(0.1750)	(0.1737)	-	-	(0.1922)	(0.1900)
Constant	-3.5188***	-3.4795***	-3.0568***	-2.9141***	-3.7844***	-3.7483***
	(0.2500)	(0.2481)	(0.3700)	(0.3674)	(0.3383)	(0.3366)
Observations	114,208	114,208	20,932	20,932	89,440	89,440

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10. The coefficients are (odds ratios).

Source: Authors' calculations based on NSS 73rd round

[9]Variable dropped because it predicts success perfectly.

5. Conclusion and Policy Implications

In the current era, and more so in the post-COVID-19regime, the importance of digital transformation is being reinforced constantly. Clearly, the pace at which consumers adopt digitalization is much faster than those of producers/sellers, especially the small ones (Business Insider, 2021).Consequently, consumer demand becomes concentrated in the hands of those who feature their products online (Deloitte, 2020). With this argument, the paper explored the possible ways to improve MSMEs' business performance through digital transformation. We attempted to answer a simple but critical question: Does the digitalization of businesses increase their likelihood of entering the export market, if yes, then through what channel? An empirical analysis using the NSS 73rd round enabled us to arrive at several insightful answers. It is found that the level of digitalization positively impacts a firm's productivity, and the effect is stronger for firms with higher productivity. Further, these outcomes hold true when the firm has access to skilled labour, implying a need for greater digital literacy. A positive link was then established between productivity complemented by digital facilities (such as access to computers and the internet) and export market entry by using a proxy variable indicating the firms' DGFT registration. Most importantly, the gains from digitalization are higher for manufacturing MSMEs than for services firms.

Our results clearly indicate that along with the export promotion policies currently in place, a greater policy focus is needed to enhance the productivity of Indian MSMEs. An important reason to focus on productivity is that the low productivity levels often discourage firms from entering the formal sector for fear of competition against highly productive organized sector firms (Kapoor, 2022). The measures to empower unorganized sector firms must take place in a way that incentivizes them to formalize, i.e., the benefits from formalization must outweigh the costs. Pushing these firms towards formalization will enable them to access various government subsidies and incentives, tax breaks, access to formal credit channels, etc., which will further enhance their productivity (Kapoor, 2022). While digitalization is an excellent catalyst for improving productivity, it must be complemented with policies and schemes that provide digital skill development and literacy. Further, the provision of subject matter experts to guide and assist the beneficiaries of government policy/schemes is crucial for effective implementation, especially in India, where a great level of firm-specific heterogeneity is present on account of varied ownership, location, challenges faced, etc. Firms with female and/or ST

category owners were seen to perform poorly as compared to others, indicating the need for an intervention from the social perspective as well. The low proportion of DGFT registered MSME firms raise concerns over their limited participation in international trade through the direct channel, despite the fact that such firms are often considered as a potential export powerhouse for the country. This also implies that MSMEs have a negligible representation at DGFT, which is the prime facilitator of trade and related policies. In 2019, a decision in the right direction was to create a section for MSMEs in the DGFT Headquarters that will act as a focal point for all the issues related to the MSME sector including the grievances received. However, it has not been materialized yet.

Although the study offers deep insights into the digitalization of unorganized sector MSMEs to the reader, one must keep in mind the time of the study. The NSS 73rd round on unincorporated non-agricultural enterprises is the latest available data source for the topic at hand. As it was conducted in 2015-16, events such as demonetization and COVID-19 that brought about an accelerated digital revolution could not be accounted for. The data source also lacked adequate information on the exporting behavior of these firms, due to which the study resorted to the use of 'DGFT registration' as a proxy. Further, the previous NSS round on unincorporated enterprises conducted in 2010-11 does not have data on MSME classification and digitalization, so a panel could not be constructed. Yet, the study has been successful in raising digitalization-related concerns and opens several areas for future research and the development of adequate databases on MSMEs for devising research-backed policies.

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