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WORKING PAPER

DIGITALIZATION AND EXPORTS: A CASE OF INDIAN MANUFACTURING MSMES

Sugandha Huria
Kriti Sharma
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Ashley Jose

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Digitalization and Exports: A case of Indian Manufacturing MSMEs

Sugandha Huria[1], Kriti Sharma[2], Neha Jain[3] & Ashley Jose[4]

Abstract: Does digitalization promote the export of Indian manufacturing Micro, Small, and Medium Enterprises? We empirically address this under-researched area by using the Centre for Monitoring Indian Economy's Prowess database consisting of around 800 manufacturing MSMEs for the period 1990-2019. The summary of the findings based on the robust econometric techniques such as the System Generalized Method of Moments and Dynamic Probit Regression Model, and employing three alternative definitions of digitalization, reveals that a higher level of digitalization of an Indian manufacturing MSME increases its exports intensity. Also, a digitalized manufacturing MSME firm is more likely to enter the export market, vis-à-vis a non-digitalized one. In fact, the likelihood further increases if digitalization is complemented with technical knowledge. The findings advocate an urgent need for manufacturing MSMEs to go for digitalization to sustain and strengthen their contribution to the Indian economy, specifically in the post-covid era.

Keywords: Digitalization, India, MSMEs, Exports, Servicification, firm-level analysis

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

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1. Introduction

The Micro, Small, and Medium Enterprises or MSMEs constitute the backbone of the Indian economy. They occupy a strategic position in India's economy, as in the case of any other emerging market and developing country. These contribute to nearly one-third of India's GDP, 40% of its non-agricultural employment, and approximately half of its exports. The sector, however, has not been able to keep pace with the 4th industrial revolution when compared to its peers. The 21st century has witnessed a massive surge in technological up-gradation in terms of increased automation, communication, robotics, cognitive computing, etc. – all of which have transformed the production, consumption, selling, and distribution operations dramatically. However, the digitalization of Indian MSMEs remains low, which, in turn, seems to have compromised its growth potential. This becomes particularly relevant with regards to its exports since most of India's competitors are way ahead of it in terms of the adoption of digital practices. During an interaction at the Confederation of Indian Industries (CII) Connect 2021, the honorable state secretary for MSMEs, Mr. V Arun Roy, also pointed out that "*Bangladesh, Vietnam, and China are leveraging into the technology-dependent economy, all with the use of cheap labour but small and medium industries in India are not showing rapid technology adoption, as only 5-10 percent of them even use computers*". The significance of digitalization was more apparent than ever during the Covid-19 pandemic. According to a WTO (2020) report, E-commerce trade increased in all the countries despite the abnormalities observed in the world trading platform. However, MSMEs in India faced a severe liquidity crunch and significant revenue losses due to a drastic decline in demand, which, in turn, not only affected the domestic production of the country but also had an acute impact on its export performance and hence, the balance of trade.

Although a few studies have explored the impact of digitalization on the export performance of firms at the global level (Atasoy, 2021; Portugal-Perez & Wilson, 2012; Tee et al, 2020; Trașcă et. al., 2019) and at the Indian level (Bhat, 2015; Banga & Banga, 2020; Gautam, 2017; Gopalan et al., 2022; Lal, 2004), none of these studies focus on the Indian manufacturing MSMEs. Considering the vast potential for improving the export potential of Indian manufacturing MSMEs via the effect of digitalization (discussed in detail in the next section), our primary objective has been to answer two questions: (i) What is the nexus between

digitalization and exports in the context of Indian manufacturing MSME firms? (ii) What is the role of digitalization in facilitating export market entry for these firms?

We also add to the literature in several other ways. First, firm-level assessment has been done by using the Centre for Monitoring Indian Economy's Prowess database, an extensive database of Indian firms, including MSMEs, consisting of around 800 manufacturing MSMEs covering the period from 1990-2019. Secondly, in contrast to Banga and Banga (2020) who have considered looking at the impact of digitalization on Indian organized sector firms (not MSMEs specifically), we have utilized three different measures of digitalization covering both capital expenditure and recurring expenditure of the firm. Further, we tackle important empirical concerns about endogeneity and unobserved heteroscedasticity by employing System Generalized Method of Moments. Fourth, to the best of our knowledge, we are the first one to check for the impact of digitalization on the export market entry decision of an Indian manufacturing MSME's by using Dynamic Probit Regression Model. Finally, the robustness of the results has been verified by controlling for a wide range of covariates such as those related to trade, labour productivity, size, age of the firm, servicification, extent of market competition, and firm-level profits.

Several important findings emerge from our analysis. First, a higher level of digitalization of an Indian manufacturing MSME increases its exports as a proportion of its total sales. Besides, greater exposure to the export market in terms of prior experience, increased labour productivity, and age of the firm is also associated with the greater export intensity of firms; Second, a digitalized manufacturing MSME firm is more likely to enter the export market vis-à-vis a non-digitalized one. Third, digitalization supported by knowledge in the form of technical know-how increases the likelihood of a firm entering the export market. The results are robust to alternative definitions of digital intensity. Recalling that the contribution of exports to India's GDP stood close to 30% in 2019 (IBEF, 2019), policy attention to the export segment cannot be compromised. Further, the MSMEs are major drivers of India's exports, therefore, given these findings, an urgent need for digital transformation is evident.

The rest of the paper is organized as follows. Section 2 of the paper sets the framework by providing the rationale to focus on manufacturing MSMEs in India and thereby analyzing their importance in the country's economy, their changing export competitiveness, and the extent of digitalization. Section 3 presents the literature review on the linkages between digitalization

and exports of firms at the global and Indian levels. Section 4 deals with empirical strategy, including the data and variables description, preliminary analysis, and empirical specifications. Section 5 discusses the estimation results. Finally, the last section concludes the paper and draws policy implications based on the government policies to foster digitalization and exports in India.

2. Setting the Framework

Importance of Manufacturing MSMEs to the country's economy

As per the National Sample Statistics (NSS) 73rd round on unincorporated non-agricultural Enterprises (2015-16), out of the 63.38 million MSMEs in India, there were about 19.66 million manufacturing MSMEs in 2015-16, with the majority (that is 99.6 percent) of them being micro-enterprises. These firms contributed to nearly 6 percent of the total GDP and generated 360 lakh jobs (that is around 32 percent of total MSMEs employment) in the year 2015-16 (NSS 73rd round, 2015-16). However, there is a declining trend in the share of manufacturing MSME output in the total manufacturing output of the country. This share has declined from 37 percent to 33 percent during 2006 – 2015 (MSME Annual Reports 2014-15 and 2016-17). At an aggregate level, not only the share of the manufacturing sector in GDP has remained stagnant at around 16 percent but it is also miserably lower than its counterparts. For instance, the manufacturing sector in East Asian economies such as Thailand, China, Malaysia, and Singapore accounts for36 percent, 30 percent, 25 percent, and 22 percent respectively of GDP.[5]

Trends in India's Manufacturing Export Competitiveness

At this point, it is difficult to draw inferences on the export performance of manufacturing MSMEs exports due to data constraints. Therefore, we begin by taking cues from the Indian manufacturing sector's export performance using the World Bank's World Integrated Trade Solutions (WITS) database. Such an analogy is possible in the light of the fact that the top manufacturing exports from India such as chemical and chemical products, food products,

[5]Ministry of Micro, Small and Medium Enterprises. (2013, September). *Recommendations of the Inter-Ministerial Committee for Accelerating Manufacturing in Micro, Small & Medium Enterprises Sector*. https://msme.gov.in/sites/default/files/Accelerating%20Manufacturing%20in%20the%20MSME%20Sector_0.pdf.

textiles, and machinery and equipment in the year 2020 also appear as top manufacturing MSME enterprises. The trends in manufacturing exports of India and changes observed in the country's comparative advantage across different manufacturing industries at an aggregate level (Table A1) reveal that despite an increase in India's manufacturing exports in absolute terms, its share in global exports has registered a decline by 0.63 percentage points during 1988 to 1998. As the Indian economy began to tread on a path of recovery (Nayyar, 1993), its share in global exports rose from 0.62 percent in 2000 to 1.7 percent in 2019, falling slightly in the year 2020 as the aggregate export growth across the world dipped during the pandemic. But the country is still far behind the potential that it used to carry during the late 1700s when the country produced nearly 25% of the world's output (Clingingsmith & Williamson, 2008).

Furthermore, it is observed from Table A2 and Table A3 in the appendix that even though the share of India's traditional sectors in world exports has declined due to the entry of many (relatively) new players (such as Bangladesh and Vietnam in Textiles and Clothing), they have been able to sustain their comparative advantage with respect to the world (reflected by increased revealed comparative advantage (or RCA) except for Textiles and Clothing, and Stone and Glass sector) over the past decade. On the other hand, the share of capital-intensive sectors such as Machinery, and Electronics, and Transportation, has increased slightly but their RCA has declined in the past decade, confirming that India's capital-intensive industries are not contributing adequately to Indian exports. This is confirmed by Baget al. (2021) who concluded that the capital-intensive sectors are increasingly becoming dependent on imports and indicate India's lack of competitiveness. This points towards a possible low pace of technology adoption (and digital adoption) by Indian firms (as capital-intensive sectors make use of tools and machinery for production), thus losing out on competitiveness in the global market.

As a result, it is critical to reflect on these challenges in order to uncover the underlying causes and develop ways to promote manufacturing output, employment, and exports of the MSMEs in the future to make it comparable to the contributions of the MSME sector of some of its global counterparts, leading in both manufacturing and services trade.[6] In this regard, it is necessary for manufacturing firms to adapt to the fourth industrial revolution since these firms

[6] In China, MSMEs contribute to 60% of the GDP of the country and account for 80% of the nationwide jobs in the country (Statista, 2021). The figure for the MSMEs GDP contribution for Vietnam is about 40 % while the sector employed about 43.2% of the workforce on an average between 2007 and 2018 (Hanoi Times, 2021; ADB, 2020). In the case of Singapore, Small and Medium-*sized* Enterprises have been contributing to 44.7 % of its GDP, while employing about 71.4 % of its workforce (ADB, 2020).

generally lag much behind in the adoption of digital practices than the services sector (Gandhi et al., 2016).

Value Added by Digital Services[7] in Sectoral Exports

One way to assess the contribution of digitalization to export performance is by looking at the value-added by digital services to Indian exports. The value added by digital services in sectoral exports of India highlights that it is the highest for the services sector which majorly comprises direct services. For all other sectors, it is less than 1%. Within the manufacturing sector, 'computer, electronics, and electrical equipment' have the highest share, which is not surprising (Table 1). A cross-country comparison in the Table reveals that the value added by digital services in manufacturing exports (as a proportion of value added by all the sectors in manufacturing exports) for India has remained stagnant for over a decade (2008-2018) and is one of the lowest among its comparators in 2018 (Table 2).

Table 1: Digital services value addition to India's sectoral exports: 2018 (% share)

Sector	Share (%)
Agriculture, forestry and fishing	0.14%
Mining and quarrying	0.46%
Manufacturing	0.53%
Food products, beverages and tobacco	0.35%
Textiles, wearing apparel, leather and related products	0.47%
Wood and paper products; printing	0.46%
Chemicals and non-metallic mineral products	0.46%
Basic metals and fabricated metal products	0.65%
Computers, electronic and electrical equipment	0.73%
Machinery and equipment	0.60%
Transport equipment	0.58%
Other manufacturing; repair and installation of machinery and equipment	0.70%
Total services (incl. construction)	31.83%

Source: Authors' calculations based on the OECD's Trade in Value Added (TiVA) database

[7]Digital Services = Sum of telecommunication services and other services such as computer programming, consultancy andinformation services activities.

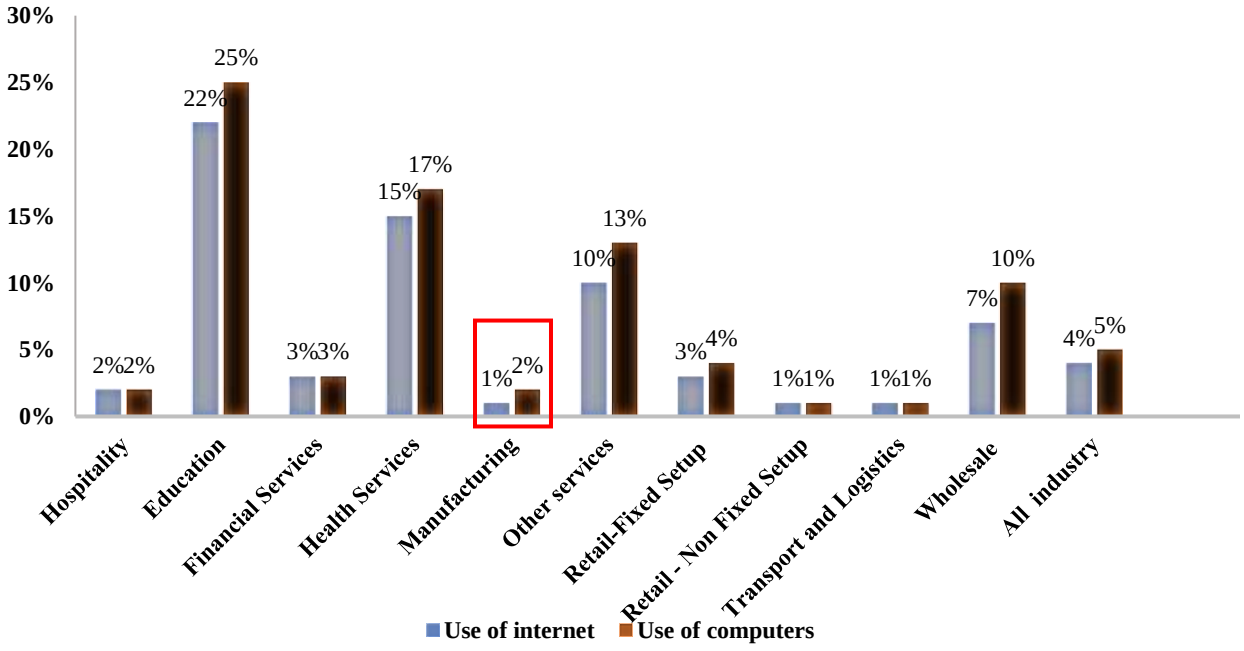
Table 2: Digital services value addition in manufacturing exports (% share)

Country/ Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
DEU	1.9	2.1	1.8	1.8	2.0	2.1	2.1	2.3	2.3	2.4	2.6
JPN	1.5	1.6	1.5	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.3
KOR	1.4	1.3	1.5	1.4	1.4	1.3	1.4	1.3	1.3	1.3	1.2
MEX	1.0	1.0	1.0	0.9	0.9	1.2	1.2	1.1	1.2	1.2	1.2
GBR	2.0	2.1	2.0	1.9	1.9	1.8	2.0	2.1	2.2	2.2	2.3
USA	1.4	1.3	1.3	1.3	1.3	1.4	1.5	1.5	1.6	1.7	1.7
BRA	2.4	2.4	1.5	1.4	1.4	1.4	1.3	1.4	1.4	1.4	1.4
CHN	1.3	1.1	1.0	0.8	0.7	0.8	0.8	0.8	0.9	1.0	1.1
IND	**0.6**	**0.6**	**0.5**	**0.6**	**0.7**	**0.5**	**0.6**	**0.6**	**0.5**	**0.5**	**0.5**
IDN	1.2	1.3	1.3	1.3	1.2	1.1	1.1	1.1	1.0	1.1	1.1
PHL	0.9	0.9	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6

Source: Authors' calculations based on the OECD's Trade in Value Added (TiVA) database

Furthermore, as demonstrated in Figure 1, among the unorganized MSMEs also, the utilization of information technology is also quite low (less than 2 percent) for manufacturing MSMEs and it is lower than the all-industry average of 5 percent.

Figure 1: Sector-wise proportion of Indian Unincorporated MSMEs using internet and computers



Source: National Sample Statistics (NSS) 73rd round on unincorporated non-agricultural Enterprises (2015-16)

Therefore, the low level of digitalization and servicification in Indian firms, particularly among manufacturing MSMEs, could be one of the several factors (for instance, India's tariff structure and trade regulations, FDI norms) responsible for India's unsatisfactory export performance and remains largely unexplored in the literature. We substantiate the latter point in the next section.

3. Literature Review

It is well known that there exists a considerable amount of literature exploring the drivers of the export performance of India. These include the effect of firm size on export intensity (Kumar & Siddharthan, 1994; Patibandla, 1995), technology, research, and development (Czarnitzki & Wastyn, 2010; Kizilkaya et al., 2016; Mohapatra, 2020), financial constraints (Mukherjee & Chanda, 2021; Nagaraj, 2014; Padmaja & Sasidharan, 2021), firm-level productivity (Goldar & Kato, 2009; Goldar et al., 2018; Haidar, 2012; Thomas & Narayanan, 2012), previous period exports (Alessandria & Choi, 2007; Bugamelli & Infante, 2003), particularly for MSMEs as their financial capacity is often considerably more restrictive, vis-à-vis the large firms (Lages & Montgomery, 2004; Love et al., 2016).

In addition, servicification in general, and utilization of imported services by manufacturing firms, in particular, have been shown to enhance their productivity, intensive (captures the surge in exports in firms that are continuing exporters) and extensive (capturing the number of firms deciding to enter the export market) margin of exports, and the probability that a manufacturing firm introduces a new service product (Bas, 2014; Goldar et al., 2018; Huria et al., 2020). Here, the relevance of complex services or business services becomes very crucial. Some of these services are computer and related activities, telecom, financial intermediation, and research& development, among others, where the role of digitalization (in general) and the intensity of firm-specific digital infrastructure becomes extremely important. Miroudot (2017) notes that services are often sold along with manufactured products in the form of bundled goods. Digitalization fosters servicification of manufacturing firms by facilitating these processes via abating costs and improving the accessibility of complex business services. Though the recent studies in the trade literature mostly focus on the impact of servicification (that implicitly incorporates the role of digitalization to some extent, more specifically in the context of the ongoing wave of globalization based on digital services, research, data, ideas, etc.

(Huria et al., 2020), a relatively limited number of existing studies have attempted to evaluate the role of digitalization in significantly impacting a firm's performance.

Digitalization of firms leads to significantly cheaper means of communication and improved access to foreign markets thereby abating distance as well as entry costs for firms (Cassetta et al., 2020). Further, it 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; Freund & Weinhold, 2004). It has also been shown how digital infrastructure, via the facilitation of better communication with customers, suppliers, and distribution networks, incentivizes firms to integrate into the Global Value Chains (Marchi et al., 2018; Gopalan et al., 2022). Borgeset al. (2009) show that digital technologies help in garnering information on competitors and help in lowering other export barriers. The digital capability of a firm also has a positive impact the product sophistication (Banga, 2018). According to Kim (2020), internet usage facilitates cross-border interactions between firms at low costs, thereby increasing their engagement with the global markets.

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. 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. A recent study by Gopalan et al. (2022) based on firms across 52 countries shows that digitalization increases the likelihood of a firm to participate in GVCs and these benefits even extend to SMEs and small agglomerates through productivity gains.

Digital practices were found to have a favourable and considerable impact on ASEAN 5 countries' service exports. (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. 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. In another study, Atasoy (2021) finds in his study of 61 countries that exports get more sophisticated as the digitalization of a firm increases.

However, the effect of digitalization on the export intensity of a firm is relatively limited in the Indian context. Lal (2004) shows 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. Bhat (2015) provides evidence for the same for the Indian pharmaceutical industry. Gautam (2017) finds on an aggregate, that Indian firms utilizing e-commerce are 21.8% more likely to be exporters and their export intensity is expected to increase by 7.9 percent. One of the recent studies 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.

Mohapatra (2020) finds that in the case of India, 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 (currently contributing to nearly half of the Indian exports) more since they face greater constraints, vis-à-vis the large firms when it comes to the export market especially so for the adoption of digital practices. The sector was also hard hit by the Covid-19 pandemic since these firms particularly the micro firms often operate with extremely limited financial capability thus not being able to buffer the economic shocks caused by the pandemic, causing a decline in domestic production as well as in exports. Digitalized firms, on the other hand, were not as affected by the outbreak when compared to their counterparts, with the pandemic acting as a catalyst for the digitalization of firms (Amankwah-Amoah, 2021; Harianto & Sari, 2021). Yet, specific literature empirically assessing the role of digitalization in promoting export intensity in the case of Indian MSMEs is missing. Summing up, an exploration of the literature has led to the identification of two research gaps. First, there exists a dearth of literature exploring the role of digitalization in promoting export intensity for Indian manufacturing MSMEs. Second, to the best of our knowledge, there is no study empirically assessing the importance of digitalization in facilitating export market entry in the case of these firms in India.

4. Empirical strategy

4.1 Data and Variables Description

The empirical assessment of the impact of digitalization on export intensity and export market entry of Indian manufacturing MSME firms has been conducted using the Centre for Monitoring Indian Economy's (CMIE) Prowess Database that collects data for organized sector firms only, i.e., registered companies that submit financial statements. It covers firms from a broad array of industries including manufacturing, services, utilities, and finance. The analysis is restricted to around 800 manufacturing MSME firms for the period 1990 – 2019. We use firm-level data on identification indicators, sales, value-added, output, exports of goods and services, import capital goods, import of raw materials and store and spares, purchase of services, net fixed assets, labour, materials, and leverage, etc. The data under consideration consists of years prior to 2020, therefore, we utilize the following definition of manufacturing MSMEs (Micro Small and Medium Enterprises Development Act, 2006):

Enterprises engaged in the manufacture or production, processing, or preservation of goods with an investment in plant and machinery of not more than Rs 10. Crores.

Table 3 explains the construction of variables used in the regression analysis for the firm-level characteristics.

Table 3: Construction/ Definitions of variables

	Variable name	Construction/ Definition
Extent of digitalization	**DigIntensity 1**	$\frac{Computer\ and\ IT\ systems}{Plant\ and\ machinery,\ computers\ and\ electrical\ assets\ +\ Exp.on\ electrical\ installations} \times 100$
	DigIntensity2	$\frac{Computer\ and\ IT\ systems + Software}{Plant\ and\ machinery, computers\ and\ electrical\ assets + Software} \times 100$
	DigIntensity 3	$\frac{Computer\ and\ IT\ systems\ +\ Software +\ Expenditure\ on\ ISPs\ for\ internet\ services}{Plant\ and\ machinery,\ computers\ and\ electrical\ assets\ +\ Software\ +\ Expenditure\ on\ ISPs\ for\ internet\ services} \times 100$
Trade	**Export intensity**	(Export of goods/total sales) * 100
	Exporter (Goods & Services)	A dummy binary variable that takes a value of 1 if the firm exports goods and/or services, and 0 if otherwise
	Importer (Goods)	A dummy binary variable that takes a value of 1 if the firm imports goods, and 0 if otherwise
	Importer (Services)	A dummy binary variable that takes a value of 1 if the firm imports services, and 0 if otherwise
	Export market entry (t)	A dummy binary variable that takes a value of 1 if the firm exports in year t, and 0 if otherwise
Labour productivity	**Labour productivity**	GVA/number of people employed, *where GVA= nominal output minus the nominal value of intermediate inputs (materials, energy, and services), deflated* *using two-digit industry-level price deflators*[8] (in INR million)
Innovation	**Technical knowhow**	Computer software, technology development, and related knowledge. However, the meaning of technical know-how is not exhaustive and includes product designs ,formulae, databases etc.
Size of the firm	**Sales**	Deflated sales (in INR million)
	Gross Fixed Assets	Deflated Gross Fixed Assets (in INR million)
Age/ Experience	**Age**	Reporting year - year of incorporation
	Age square	Age*Age
Servicification	**Service input intensity**	(Services purchased/sales) * 100, *where services purchased include the Sum of expenses on heterogeneous services comprising rent and lease, repair and maintenance, outsourced manufacturing jobs, outsourced professional jobs, insurance, selling and distribution expenses, and financial services, measured in current prices.*
Leverage	**Debt to equity ratio**	Total debt of the firm/total equity of the firm

Source: Prowess database

[8] The deflators were obtained by matching two-digit NIC codes with KLEMS codes for the years 1988-2017, obtained from the website of Reserve Bank of India. The base year is 2011-2012. For the years 2018 and 2019, the price deflators were calculated using National Accounts Statistics (NAS) data from the website of the Ministry of Statistics and Policy Implementation (MOSPI), Government of India

The key variable of interest is the Digital Intensity of the firms. We utilize three (slightly) different definitions of digital intensity (based on the availability of data) for our analysis. The first definition is based on the capital expenditure of the firm consistent with the one used in Banga and Banga (2020). Since we also have information on software and internet charges in prowess, which reflects recurring expenditure incurred by the firms, we added these components to get an alternative definition of digitalization. This has been done to verify if our empirical results are robust to different definitions/forms of digitalization. Furthermore, recurring expenditure constitutes a significant part of total costs of production for small firms, especially the ones involved in manufacturing. The selection of other firm-level characteristics such as various trade indicators (export intensity, whether the firm is an exporter of goods and/or services, whether the firm is an importer of goods and services, whether the firm enters the export market), innovation (proxied by technical knowhow assets of the firm), a measure of labour productivity (defined by Gross Value Added per worker), size of the firm (proxied by deflated sales or deflated gross fixed assets), age of the firm (proxied by the square of the difference between reporting year and year of incorporation), level of servicification of the firm (measured by services purchased as a proportion of sales of firm), and leverage of the firm (measured as debt-equity ratio), has been based on the literature review and intuition of the researchers.

Table 4: Summary Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Digital intensity 1	42,202	1.91	6.42	0	100
Digital intensity 2	42,209	2.58	7.47	0	100
Digital intensity 3	40,030	2.71	7.88	0	100
Technical knowhow	42,065	1.31	25.15	0	3154.53
Export intensity	42,300	11.96	13.95	0	100.00
Exporter (Goods & Services)	42,300	0.99	0.09	0	1
Labour productivity	42,274	0.83	3.24	0	320.22
Importer (services)	42,300	0.70	0.46	0	1
Service input intensity	42,034	14.34	50.90	0	6300.00
Importer (goods)	42,300	1	0.05	0	1
Size (Deflated sales)	42,300	0.01	0.09	0	5.86
Size (Gross Fixed Assets)	42,263	5018.75	29709	0.26	1501259
Age	42,296	28.68	19.44	0	146
Debt/equity ratio	39,307	2.72	47.20	0	5792

Source: Authors' calculations from Prowess database

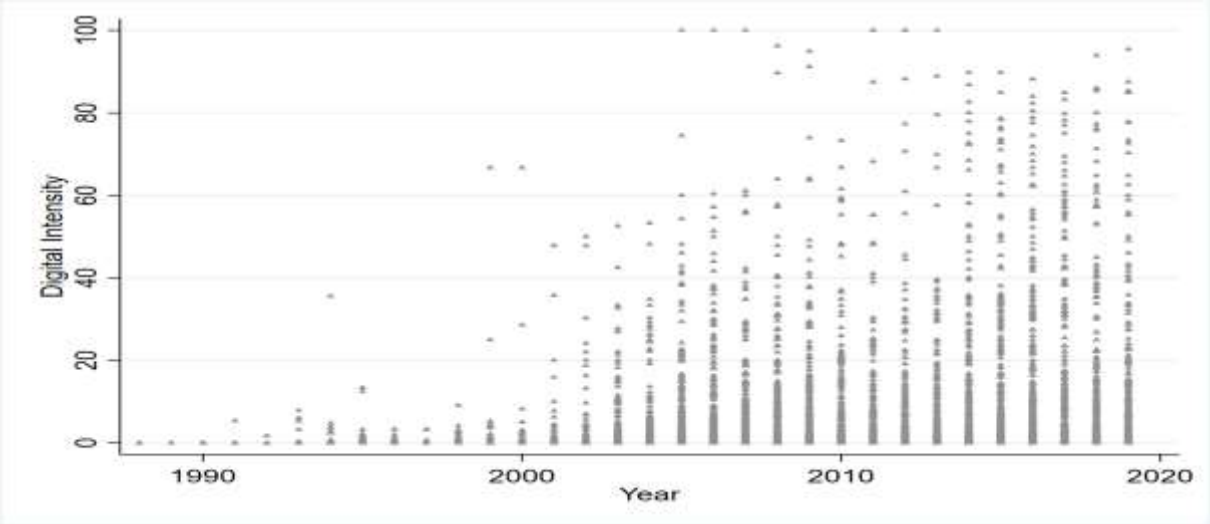
The summary statistics presented in Table 4 reveal that the level of digitalization as captured by various definitions of the digital intensity of the firm varies from 0 to 100 percent with an average of around 2.5 percent. The average export intensity is 12 percent in our sample. Other firm-level characteristics also display stark disparities.

4.2 Preliminary Analysis

Figure 2 gives a graphical representation of the gradual change in digital intensity of India's incorporated MSMEs from 1990-2019 based on the Prowess database. The scatterplot shows that even though the concentration of firms at low levels of digital intensity remains high, the digital assets of a firm as a proportion of its total fixed assets have increased during 1990-2019 with a significant jump since the mid-2000s. This is an indication of increased digitalization levels among incorporated MSMEs. Next, we explore the relationship between digital intensity and export intensity of incorporated MSMEs over the years (Figure 3). Both the measures display an

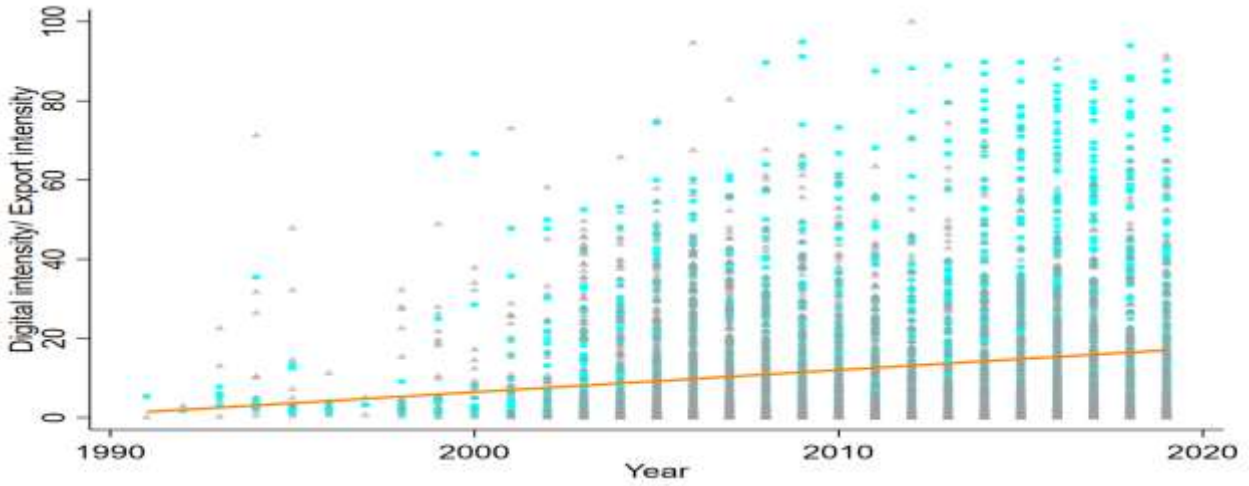
upward trend from 1990 to 2020, indicating a positive relationship between digital intensity and export intensity of incorporated MSMEs.

Figure 2. Digital intensity of Indian incorporated Manufacturing MSMEs (1990-2019)



Source: Authors' calculations from Prowess database

Figure 3. Trend between digital intensity and export intensity of Indian incorporated MSMEs (1990-2019)



Where -indicates fitted values of digital intensity, indicates export intensity and indicates digital intensity of firms over the 1990-2019 time period.
Source: Authors' calculations from Prowess database

We extend the analysis further by assessing the impact of digital intensity on a firm's export intensity using independent samples't' test. Table 5 reports our findings.

Table 5: Testing for the differences in export intensity across low and high digital intensity firms

Variable	Obs.	Average export intensity	SE	Standard Deviation	95% Confidence Interval		T stat for H_0	Significantly different means?
Low Digital Intensity	6596	13.51	0.19	15.35	13.14	13.88	4.30***	Yes
High Digital Intensity	6590	12.39	0.18	14.67	12.04	12.75		

Note: H_o: Export Intensity$_0$ = Export Intensity$_1$
H_a: Export Intensity$_1$ >Export Intensity$_0$
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source: Authors' calculations from Prowess database

Here, the null hypothesis (H_o) states that the average export intensity of firms (Export Intensity$_0$) with a lower level of digitalization (that is those firms whose digital intensity is less than the median industry level) is significantly equal to the average export intensity of the firms (Export Intensity$_1$) with a higher level of digitalization. The results from the independent samples t test hypothesis reject the null hypothesis and indicate a statistically and significantly higher value of average export intensity (exports as a proportion of sales) for manufacturing MSME firms whose digital intensity lies in the above median industry level. The next sub-section substantiates this result using regression analysis.

4.3 Empirical Specification

We attempt to assess the impact of digitalization in boosting exports of a manufacturing MSME firm as a proportion of its total sales using the following model specification for the period 1990-2019:

$$\text{Export Intensity}_{i,t} = \alpha + \beta_1 \log(\text{Digital Intensity}_{i,t}) + \beta_2 \text{ Export Intensity}_{i,(t-1)} + \beta_3 \text{ Export Intensity}_{(t-2)} + \beta_4 \log(\text{Labour Productivity}_{i,t}) + \beta_5 \text{ Importer Dummy}_{i,t} \text{ (Services Inputs)} + \beta_6 \text{ Importer Dummy}_{i,t} \text{ (Goods)} + \beta_7 \text{ Service Input Intensity}_{i,t} + \beta_8 \log(\text{Sales}_{i,t}) + \beta_9 \text{ Age square}_{i,t} + \beta_{10} \text{ Debt to Equity Ratio}_{i,t} + €_{it} \quad (1)$$

where *Export Intensity*$_{i,t}$ is the share of exports of goods in sales of firm *i* at time *t*. This is regressed on one and two-year lagged values of *export intensity* to capture the effect of sunk

cost (e.g., Goldar, 2018; Padmaja & Sasidharan 2015, 2017). The impact of the main predictor variable, digital intensity, is shown by taking its alternative definitions in different specifications. β is the coefficient for explanatory variables. Other explanatory variables comprise the lagged export intensity of firms, technical know-how assets, imports of goods and services, the experience of the firm, size of the firm, debt-equity ratio, and service input intensity of the firm serve as the control variables for the analysis. The model controls for time and industry fixed effects and $€_{it}$ is the error term.

Due to the presence of unobserved firm characteristics (that may be correlated with both export intensity and digital intensity), the Ordinary Least Squares estimates will be inconsistent as well as biased. The explanatory variables also include lagged values of the dependent variable, indicating the presence of endogeneity in the data, therefore fixed effects estimates won't give the desired outcome. We employ the System Generalized Method of Moments estimator to control for endogeneity and unobserved heteroscedasticity. For System GMM, we have used Roodman (2009) xtabond2 command in Stata, with two-step GMM estimation and robust standard errors, confined to those firms whose investment in plant and machinery is not more than Rs. 10 crores (or the MSME firms). This allows for maximum efficiency and robustness to heteroscedasticity and autocorrelation. Hansen's J test of over-identifying restrictions is used to verify the correctness of system GMM estimations (Arellano & Bond, 1991). A *p-value*>0.05 leads us to the conclusion that all the restrictions in the equation are valid. Additionally, the result must also be accompanied by a *p value* > 0.05 at AR(2) level to ensure that there is no second-order serial correlation in the first difference residuals. The number of instruments included in the model is less than the number of groups in the panel in line with Roodman (2009). Finally, the model also controls for unobservable industry and year variables by adding industry and year fixed effects.

Next, we assess whether the level of digitalization affects a manufacturing MSME's decision to enter the export market or not. Our model specification (Equation (2))proposes that a firm's decision to export in a particular year depends on its level of digitalization, technical knowhow, lagged export status, lagged import of goods, lagged import of services, servicification, lagged labour productivity, size proxied by gross fixed assets, experience, and leverage of the firm. The model specification is as follows:

$$\text{Export market entry}_{i,t} = \alpha + \beta_1 \log(\text{Digital Intensity}_{i,t}) \times \text{Technical knowhow}_{i,t} + \beta_2 \text{Exporter(Goods\& Services)}_{i,t-1} + \beta_3 \log(\text{Labour Productivity}_{i,t-1}) + \beta_4 \text{Importer (Services)}_{i,t-1} + \beta_5 \text{Importer(Goods)}_{i,t-1} + \beta_6 \text{Service Input Intensity}_{i,t} + \beta_7 \log(\text{Gross Fixed Assets})_{i,t-1} + \beta_8 \text{Agesquare}_{i,t} + \beta_9 \text{Debt to equity ratio}_{i,t} + u_i + \epsilon_{it} \quad (2)$$

where the dependent variable *Export market entry*$_{i,t}$ can only take two values, i.e. 1 if the firm exports and 0 otherwise. Therefore, a dynamic Probit regression model is used to determine the factors influencing the decision to enter the export market by an MSME firm. The impact of the key explanatory variable, digital intensity, is shown by taking its alternative definitions in different specifications. This model also takes into consideration the interaction effects between the digital intensity of a firm and its technical know-how. By introducing the interaction effect, we seek to investigate the importance of digitalization supported by technical knowledge in facilitating export market entry. β is the coefficient for explanatory variables. The variable 'Exporter (Goods) $_{i,(t-1)}$' reflect the previous year's export status of the firm. The rest of the other explanatory variables have usual interpretations. u_i are (unobserved) individual-specific random effects, and the ϵ_{it} is assumed to be normally distributed with zero mean and constant variance. We also account for industry and year-fixed effects.

5. Estimation Results

Table 6 reports the results of the impact of digitalization on the export intensity of the manufacturing MSME firms based on the System – GMM.

Table 6: System GMM results: dependent variable = export intensity

VARIABLES	Export Intensity (t)					
	(1)	(2)	(3)	(4)	(5)	(6)
Log (Digital Intensity 1)	1.9860**			1.1874		
	(0.8310)			(1.0611)		
Log (Digital Intensity 2)		1.5305**			0.9730	
		(0.7698)			(1.1275)	
Log (Digital Intensity 3)			1.6477***			1.7085**
			(0.5593)			(0.7751)
Technical knowhow	1.0671***	1.0625***	1.0852***	1.4528**	1.2944*	1.2198*
	(0.0960)	(0.0924)	(0.0782)	(0.6198)	(0.7353)	(0.7132)
Export Intensity (t-1)	0.6270***	0.6226***	0.6398***	0.1473	0.1390	0.1627*
	(0.0608)	(0.0595)	(0.0624)	(0.0987)	(0.0963)	(0.0914)
Export Intensity (t-2)	0.0680	0.0611	0.0847	0.0162	-0.0044	0.0530
	(0.0500)	(0.0487)	(0.0541)	(0.0463)	(0.0459)	(0.0445)
Log (Labour Productivity)	4.9979***	4.6725***	6.7368***	6.0972**	6.5677**	7.4867***
	(1.6956)	(1.5882)	(1.8454)	(2.5102)	(2.6086)	(2.7279)
Importer (Services)	1.5295**	1.3875**	1.2723**	1.1525	-0.0407	0.4939
	(0.5943)	(0.5637)	(0.6131)	(1.7129)	(1.6767)	(1.4354)
Service input intensity	0.1526**	0.1489*	0.1435*	0.1996	0.1982	0.1779
	(0.0773)	(0.0767)	(0.0805)	(0.1434)	(0.1801)	(0.1574)
Importer (Goods)	0.5631	-2.1236	-1.6549	0.4881	-1.9625	-2.0408
	(3.0448)	(3.0246)	(2.9880)	(3.6812)	(4.5934)	(4.9588)
Size (log(Sales))	-1.6236	-1.0705	-2.2712**	-3.4806	-3.8311*	-3.2778
	(1.0073)	(0.9740)	(1.1265)	(2.2533)	(2.0459)	(2.0617)
Age square	-0.0001	-0.0000	0.0002	0.0038	0.0025	0.0023
	(0.0002)	(0.0002)	(0.0003)	(0.0080)	(0.0082)	(0.0076)
Debt to Equity Ratio	0.0005	0.0017	0.0208	0.0619*	0.0296	0.0377
	(0.0356)	(0.0342)	(0.0411)	(0.0346)	(0.0513)	(0.0410)
Constant	-12.5989	-4.8856	-13.8083	-90.7115	-76.0186	-51.2452
	(9.0474)	(8.9109)	(9.8403)	(75.7899)	(81.6843)	(88.6093)
Year Fixed Effects	.	.	.	Yes	Yes	Yes
Industry Fixed Effects	.	.	.	Yes	Yes	Yes
Observations	1,696	1,813	1,711	1,696	1,813	1,711

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.10

Source: Authors' calculations from Prowess database

It is found that the level of digitalization, calculated by employing all the three alternative definitions of digital intensity, has a positive and statistically significant impact on the export intensity of the firm. When industry and year fixed effects are not accounted for, the results are similar to the findings of Banga and Banga (2020), that is firms with a higher share of computer and IT systems' expenditure (with or without software and internet services expenditure) in their total plant and machinery expenditures are found to have higher export intensity in the period 1990-2019 in India, other things remaining the same. The important difference to note over here is that while Banga and Banga (2020) took all manufacturing firms into consideration, the current study takes specifically manufacturing MSME firms, a comparatively under-researched area. When we account for industry and year fixed effects, it is found that only Digital Intensity 3 has a significantly positive impact on Export Intensity. This implies that the hardware system of a manufacturing MSME firm must be complimented with internet services to have significant improvement in their export intensity (Nicoletti et al., 2018). This reinforces the importance of having access to the internet when participating in international trade (Clarke, 2008; Fernandes et al., 2019; Gopalan et al., 2022; Kim, 2020;). Digitalization can thus be seen to provide a competitive edge to firms in the export markets and encourage them to increase their share of exports in total sales through improved access to market information and increased firm productivity, as asserted by Dethine et al. (2020), Lal (2004), Bhat (2015), and Gautam (2017).

Among covariates, the impact of labour productivity on a firm's export intensity is also found to be positive and significant (Alvarez, 2002; Banga & Banga, 2020). As Bigsten and Gebreeyesus (2009) and Haidar (2012) put it, the result is in line with the self-selection hypothesis that says more productive firms self-select themselves into the export market. Similarly, in line with the literature (Agnihotri & Bhattacharya, 2015; Meinen, 2015; Goldar, 2018; Padmaja & Sasidharan 2017;), sunk cost, captured by lagged terms of export intensity has a positive and highly significant impact on the export intensity of MSMEs. This confirms that if the firm has undertaken export-related costs in the previous period, its export intensity will register an increase in the current period. Specifically, a 1 unit increase in export intensity in the previous period leads to an increase of 0.62 units increase in the export intensity of the current period, keeping other factors constant. If industry fixed effects and year fixed effects are together considered, the impact reduces to 0.16 units.

Even though a very small proportion of Indian MSMEs are servicified, the impact of servicification on MSMEs is positive and significant. This happens through various channels such as transportation, distribution, financial, and other professional services (Bas & Kahn, 2014; Goldar et al., 2018; Huria et al., 2020; Mukherjee, 2015; Pattnayak & Chadha, 2022). A 1 unit increase in the use of services by the firm increases its export intensity by 0.15 units. The coefficient of import of services is also seen to have a statistically significant and positive impact on export intensity in a few of the iterations. These findings are supported by Bas and Kahn (2014) and Meinen (2015). Technical know-how assets of the firm that capture its knowledge about software, database, product design, etc. are seen to be highly influential for the firm's export intensity. This reflects the competitive advantages gained through research, development, and innovation by a firm in global markets (Forman & Van Zeebroeck, 2019). Leverage, defined in terms of debt-equity ratio, is seen to have a positive, although the insignificant impact on export intensity. Finally, contrary to the existing empirical evidence of larger firms displaying higher export intensity (Banga & Banga, 2020; Bekteshi, 2020), the coefficients of firm size and firm experience turn out to be negative in the above analysis, which is consistent with the findings of Monteiro (2013). The empirical evidence for a firm's age on its export intensity is found to be ambiguous in the literature. In line with our findings, however, Fryges (2006) finds that newer firms display higher export intensity due to the possession of more novel technology. As mentioned above, the robustness of the results has been verified by employing alternative definitions of digital intensity. To the best of our knowledge, no such findings have been established for the Indian MSMEs. Gopalan et al. (2022) have also used three different proxies for digitalization in their study. However, their findings do not specifically focus on MSMEs, but on different firms across 52 countries, including India.

Table 7 presents the Dynamic Probit results corresponding to our second empirical specification (Equation 2).

Table 7: Dynamic Probit results: Factors affecting the entry of firms into the Export Market (odds ratios)

VARIABLES	Export Market Entry					
	(1)	(2)	(3)	(4)	(5)	(6)
Log(Digital Intensity 1)	0.1246**			0.3184***		
	(0.0532)			(0.1174)		
Log(Digital Intensity 2)		0.1093**			0.2640***	
		(0.0509)			(0.0984)	
Log(Digital Intensity 3)			0.0989*			0.2407
			(0.0515)			(0.3017)
Technical knowhow	-0.6699*	-0.6428*	0.3043	-218.8340***	-326.7633***	0.1755
	(0.3897)	(0.3570)	(0.4597)	(59.5182)	(101.4235)	(0.3433)
Log(Digital Intensity 1) x Technical knowhow	1.0630**			292.2030***		
	(0.4287)			(80.4877)		
Log(Digital Intensity 2) x Technical knowhow		0.9960**			435.3687***	
		(0.4105)			(136.5867)	
Log(Digital Intensity 3) x Technical knowhow			0.6056*			0.2542
			(0.3150)			(0.3468)
Exporter (Goods & Services)(t-1)	0.6678*	0.6961**		0.2463	0.2985	
	(0.3487)	(0.3439)		(0.4501)	(0.4382)	
Log(Labour Productivity) (t-1)	0.0106	-0.0020	0.0404	0.0716	0.0555	0.1122
	(0.0873)	(0.0867)	(0.0790)	(0.1235)	(0.1224)	(0.1163)
Importer(Services)(t-1)	0.3448**	0.3574**	0.2637	0.4284*	0.4712**	0.3592
	(0.1752)	(0.1721)	(0.1645)	(0.2257)	(0.2178)	(0.4249)
Services Input Intensity	-0.0046	-0.0049	-0.0017	-0.0278*	-0.0254*	-0.0184
	(0.0087)	(0.0086)	(0.0091)	(0.0149)	(0.0137)	(0.0208)
Importer(Goods)(t-1)	0.8076	0.7396	0.8698	0.2540	0.1873	0.0922
	(0.5883)	(0.5528)	(0.5292)	(0.5387)	(0.5130)	(1.0314)
Log(Gross Fixed Assets)	-0.1728**	-0.1705**	-0.1114	-0.4513***	-0.3998***	-0.2841**
	(0.0793)	(0.0790)	(0.0827)	(0.1625)	(0.1446)	(0.1249)
Age square	-0.0001*	-0.0001*	-0.0001**	-0.0001**	-0.0001*	-0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0001)
Debt to Equity ratio	-0.0001					
		-0.0007	-0.0017	-0.0020	-0.0040	-0.0062
	(0.0052)	(0.0050)	(0.0056)	(0.0057)	(0.0052)	(0.0079)
Constant	1.6356**	1.6914**	1.9884***	3.5067**	3.2714**	3.2505
	(0.6779)	(0.6664)	(0.6413)	(1.4989)	(1.4134)	(0.0000)
Year fixed effects	.	.	.	Yes	Yes	Yes
Industry fixed effects	.	.	.	Yes	Yes	Yes
Observations	2,528	2,685	2,480	783	846	652

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.10

Source: Authors' calculations from Prowess database

From table 7, it is observed that a higher level of digitalization is seen to increase the predicted likelihood of a firm's entry into the export market. On the other hand, technical know-how is now seen to have a significantly negative impact on the same. Yet, the variable that captures the interaction between these two variables has a positive and statistically significant coefficient. This illustrates the importance of digitalization in optimum utilization of knowledge through the development and improvement of innovation capabilities. In other words, technical knowledge alone does not facilitate export market entry unless it is complemented by digital technologies. Additionally, the coefficient of the interaction variable is much higher in magnitude than that of digital intensity. This is indicative of a two-way complementarity between the use of technology and knowledge (Bagale et al., 2021; Brunetti et al., 2020; Mäki & Toivola, 2021). Thus, digitalization not only has a positive influence on the export intensity of a firm but also contributes positively and significantly to the decision to start exporting by an MSME firm (Lal, 2004; Bhat, 2015; Gautam, 2017; Banga and Banga, 2020). The result substantiates the findings of a very recent study by Gopalan et al., (2022) which finds that digitalization increases a firm's likelihood in GVC participation. In line with the literature (Agnihotri & Bhattacharya, 2015; Meinen, 2015; Padmaja & Sasidharan 2017; Goldar, 2018), in some of the iterations considered, the previous exporting behaviour of a firm significantly impacts its decision to enter the export market in the current year. Typically, a firm's experience and exposure to exports in the past increases its likelihood of entering the export market in the current period. Similarly, import of services heavily influences the decision of a firm to start exporting by providing them with the right exposure to international trade (Meinen, 2015). Labour productivity appears to have a positive impact on the export market entry of the given firms, although it is not statistically significant unlike the previous case where we analyzed the determinants and facilitators of the export intensity of a manufacturing MSME Size, as denoted by the log of Gross Fixed Assets of the firm, is found to have a negative impact on the firm's decision to export, somewhat in line with the findings of equation 1 and results of Monteiro (2013). This finding contrasts with several studies which suggest that larger firms are more likely to undertake the decision of entering the export market (Banga & Banga, 2020; Bekteshi, 2020; Ruzzier & Ruzzier, 2015; Srinivasan & Archana, 2011). Experience is once again seen to have a negative coefficient in this model, statistically significant in some of the iterations, implying that digitalized young

MSMEs have higher chances of entering the export market than their older counterparts. Young enterprises are more adaptable to new production methods due to their urge to stay competitive (Upward et al., 2013).

6. Conclusions and Policy Implications

This study makes an attempt to assess the role of digitalization in impacting export intensity and influencing export market entry in the case of Indian Micro, Small, and Medium manufacturing enterprises, which are considered as potential export powerhouses to contribute toward the aim of making India a USD 5 Trillion economy. We deal with these questions using the CMIE's prowess database entailing information on the organized sector MSMEs for the period 1990-2019. Correcting for unobserved heterogeneities and the possibility of the issue of endogeneity, our empirical assessments suggest digitalization of an Indian manufacturing MSME is associated with higher export intensity – an extremely crucial result from a policy perspective given the pace at which digitalization is changing the economics of globalization in several ways. Moreover, a digitalized firm is more likely to enter the export market than a non-digitalized MSME firm. Finally, the effect of digitalization on a firm's export market entry becomes even more prominent when it is complemented with technical know-how. The results are robust to different variations of digital intensity covering fixed expenditures on the computer and IT systems, and recurring expenditures on software and internet services.

Yet, there are several reasons why a reader needs to be cautious while interpreting these results. For instance, these results may vary if checked for different industries within the manufacturing sector depending upon their nature (labour or capital intensive) (Manjappa & Mahesha, 2013). Further, even as the scope and meaning of digitalization widen with each passing day, the study has attempted to capture it in the best way possible, given the data availability in the Prowess database. Last but not the least, the study takes firm-level continuous time-series data from CMIE Prowess that collects data from the firms' financial statements and is therefore available for the organized sector only. The NSS 73rd round sample survey on unincorporated enterprises does help in bridging this gap to some extent, however, it is only available for the year 2015-16. The data is not only obsolete considering that the major wave of digitalization hit India in the recent few years, but the previous round of the survey (NSS 67th

round, 2010-11) also lacked data on digitalization and MSME classification. Additionally, the time gap between successive NSS rounds also makes it impossible to conduct a continuous time series analysis.

Despite its limitations (which could also be interpreted in terms of future scope of research in this area), the findings of this study advocate an urgent need for the digitalization of the MSMEs to sustain and strengthen their contribution to the Indian economy and to capture a greater share of global trade. This, in turn, points our attention to whether the Indian MSMEs are capable of digital transformation? Their future growth prospects are threatened by the widening digital divide as became evident during the Covid-19-led economic crisis. While the large firms explored new avenues of growth with the help of digital presence and availability of adequate digital infrastructure, the small ones were left gasping for breath as most of them depend on traditional methods of production and marketing. The issue necessitates a great deal of attention since the literature on the digitalization of Indian MSMEs is extremely scanty, and so is the availability of data for sound research on an exhaustive set of both organized and unorganized MSMEs. Though the Indian government has introduced numerous schemes such as Digital MSME Scheme (2017), Pradhan Mantri Gramin Digital Saksharta Abhiyaan (2017), Udyam registration (2020), PayGov India (2016), Digidhan Abhiyaan (2016), Aadhaar Enabled Payment System (2019), and many others to improve digital penetration, encourage online transactions, provide digital literacy, particularly to the rural population, improve the basic infrastructure such as the availability of electricity, etc., the pace of digitalization in Indian MSMEs is still low compared to other countries. This could point towards the prevalence of several lacunas faced by Indian MSMEs such as lack of awareness among Indian MSMEs regarding eligibility, procedures, grievance redressal, and potential benefits of the government schemes (FE Online, 2022); the complicated regulatory landscape for export-related payments in India; the exclusion of needy firms, particularly micro-firms that form the biggest chunk of MSME firms, from the eligibility criteria for availing of the benefits of the scheme; financial distress due to lack of economies of scale in small-scale production and inadequate revenues (Gopalakrishnan & Reddy, 2022). As a result, future research should look at the problems faced by Indian MSMEs in adopting digitalization and the effectiveness of government programs to foster digitalization.

To sum it up, it can be said that the growing use of digital technologies is revolutionizing how businesses operate and therefore a strategic embrace of new technologies, enhanced networking, and greater policy intervention are needed to redefine the digitalization path of Indian MSMEs.

Declaration of Conflict of Interest: None

Data availability statement: Data supporting the findings of this study are available from the corresponding author on request.

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APPENDIX

Table A1. Export Competitiveness of Indian Manufacturing sector (1988-2020)

Year	India's global exports (USD bn)	India's share in global exports (%)	Y-O-Y growth in exports (%)	Y-O-Y growth in India's share in global exports (%)
1988	11.78	1.55		
1989	14.62	1.29	0.24	-0.17
1990	15.51	1.19	0.06	-0.08
1991	15.35	0.85	-0.01	-0.29
1992	18.16	0.79	0.18	-0.07
1993	19.36	0.73	0.07	-0.08
1994	22.84	0.65	0.18	-0.11
1995	26.65	0.61	0.17	-0.06
1996	28.61	0.61	0.07	0.00
1997	29.72	0.59	0.04	-0.02
1998	27.94	0.56	-0.06	-0.06
1999	31.97	0.62	0.14	0.10
2000	37.49	0.62	0.17	0.01
2001	38.89	0.67	0.04	0.08
2002	44.50	0.73	0.14	0.09
2003	53.81	0.76	0.21	0.03
2004	69.21	0.80	0.29	0.06
2005	92.50	0.95	0.34	0.18
2006	113.19	0.99	0.22	0.04
2007	135.62	1.04	0.20	0.05
2008	169.07	1.13	0.25	0.09
2009	165.76	1.43	-0.02	0.26
2010	206.33	1.45	0.24	0.02
2011	278.67	1.64	0.35	0.13
2012	259.20	1.53	-0.07	-0.07
2013	303.23	1.72	0.17	0.13
2014	284.83	1.63	-0.06	-0.05
2015	238.29	1.56	-0.16	-0.04
2016	235.51	1.59	-0.01	0.02
2017	264.87	1.62	0.12	0.02
2018	293.62	1.63	0.11	0.01
2019	295.68	1.71	0.01	0.05
2020	247.41	1.54	-0.16	-0.10

Source: Authors' calculations based on the World Bank's World Trade Integrated Solutions (WITS)

Table A2: India's share in global sectoral exports

Industry/Year	1988	1995	2000	2005	2010	2015	2016	2017	2018	2019	Average growth rate (2015-2019)
Food Products	3.34	0.71	0.59	0.66	1.2	1.08	1.10	1.09	1.11	1.22	1.12
Minerals	12.53	2.42	2.09	6.06	3.6	1.27	1.65	1.69	1.54	1.84	1.55
Fuels	0.21	0.14	0.12	0.05	1.7	0.38	0.40	0.51	0.66	0.85	0.51
Chemicals	1.52	1.74	1.50	1.13	1.7	0.73	0.67	0.74	0.81	0.71	0.74
Plastic/Rubber	0.36	0.40	0.40	0.28	0.8	0.45	0.38	0.36	0.33	0.28	0.38
Hides and Skins	9.45	7.20	7.77	5.93	2.5	2.90	2.74	2.34	2.45	2.62	2.73
Wood	0.15	0.08	0.07	0.06	0.3	0.09	0.09	0.09	0.07	0.07	0.08
Textiles, Clothing	6.05	5.41	5.74	4.68	4.3	2.77	2.67	2.92	2.65	2.63	2.78
Footwear	5.52	3.81	3.81	3.26	1.7	1.27	1.22	1.12	1.02	1.20	1.24
Stone and Glass	13.51	3.84	4.54	5.70	6.1	5.14	5.59	5.45	5.27	5.03	5.23
Metals	0.70	0.51	0.74	1.31	2.0	1.98	1.94	2.42	2.05	2.17	2.10
Machinery, Elec	0.30	0.12	0.12	0.25	0.5	0.51	0.53	0.56	0.65	0.75	0.59
Transportation	0.19	0.17	0.14	0.36	1.1	1.29	1.17	1.21	1.20	1.27	1.27

Source: Authors' calculations based on the World Bank's World Trade Integrated Solutions (WITS)

Table A3: Revealed comparative advantage (RCA) across sectors in India: 2010, 2019

Industry/ Year	2010	2019
Food Products	1.07	1.56
Minerals	1.51	1.66
Fuels	0.82	0.69
Chemicals	2.45	1.04
Plastic or Rubber	1.14	1.21
Hides and Skins	1.18	1.61
Wood	0.56	0.75
Textiles and Clothing	1.69	1.52
Footwear	0.22	0.42
Stone and Glass	2.90	2.61
Metals	1.18	1.08
Machinery and Elec	4.10	2.84
Transportation	1.37	1.22

Source: Authors' calculations based on the World Bank's World Trade Integrated Solutions (WITS)

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