Digitalization, Firm performance, and Internationalization of Micro Firm in India

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Abstract

Digitalization has brought about radical changes in the pattern of production and international trade. How this digital revolution impacts firms especially micro firms is yet to be explored. In this study using a rich survey data on 836 micro firms from India, we examine the nexus between digital adoption and firm performance and internationalization. Using twelve unique parameters of digitalization that captures the multi-dimensional nature of digitalization, we find that use of internet in general plays a significant role in improving firm sales, output per worker and enabling export participation. Furthermore, drawing from the twelve different parameters, we find that use of social media has a significant association with increase in firm sales, and output per worker. In contrast, use of digitalization for purchase of inputs, tracking of inputs, and payment to suppliers, is positively associated with greater propensity to export for our sample of Indian micro firms.

Key words: Digital Adoption; Export; Social Media; Digital Payments; Micro-enterprises

JEL: D22; F14; L25

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1. Introduction

The rise of digitalization over the past two decades has transformed business, with digitalization featuring as a fundamental input in firms modus operandi. Transforming existing system of global manufacturing digitalization plays an important role, both for sustaining production activities, but also for leveraging digitalization for improved economic gains (Hoekman & Shepherd, 2015; Taglioni & Winkler, 2016). With advancements in ICT across the globe, there is a growing body of studies that identifies ICT and related advancements as a key determinant of productivity and internationalization (Haller & Siedschlag, 2011, Gopalan et al., 2023). Further, improvement in firm performance stems from digitalization and investment in ICTs which leads to operational efficiency for firms, greater innovation impetus, and improved resource allocation (Yoo et al., 2010; Manyika et al., 2015). For instance, Fuentelsaz et al. (2009) highlight digitalization of the production process enhances technical and operating efficiency resulting in productivity enhancement. In a similar vein, Wroblewski (2018) note that digitalization also enables firms to track its inputs and predict its demand effectively, thereby reduce its mismatch with inventory resulting in improved operation efficiency.

From a trade perspective, numerous studies have also explored the digitalization and internationalization nexus documenting the enabling effects of digitalization on internationalization. With digitalization, firms are able to reduce the distance barrier thereby reducing their entry costs to foreign firms (Cassetta et al., 2020). Moreover, digitalization enabling better connectivity with distribution networks, and customers, and promotes greater flow of intermediate inputs thereby resulting in greater internationalization of firms (De Marchi et al., 2018; Cardona et al., 2013). Furthermore, digitalization gained greater prominence with the on-set of the Covid-19 pandemic, with studies highlighting that during this phase of turbulent economics and trade environment, firms that were more digitalized showcased greater level of resilience and robustness to this unprecedented shock (UNIDO, 2021; Miroudout, 2020). In terms of the literature governing India, in a recent study, Reddy & Sasidharan (2023) empirically highlight the importance of digitalization proxied by ICT related investments on global value chain (GVC) integration of Indian manufacturing firms.

However, despite studies emphasising the importance of digitalization for firm performance and the subsequent paradigm shift in firms operation across the globe, there still remains two significant gaps in the literature. First, given the complex nature of digitalization, majority of the existing studies proxy digitalization via firms investment in information and communication technologies (ICT). Though this represents the potential of ICT adoption by a firm, it does not necessarily reflect the true adoption scenario. In this regard, certain studies have tried to overcome this limitation with use of indicators such as website adoption or email usage. Although these measures do reflect digital adoption by firms, it fails to capture multitude of different adoption parameters. Our study bridges this gap by looking at twelve parameters of digital adoption and thereby advancing the literature on digital adoption. Second, a key aspect of digital adoption is use of digital payments by firms. Hence, despite studies exploring implications of digitalization on various firm strategies, research on digital payments and its implications remains scant. Our study contributes to this important strand of literature.

Third, another key feature of the existing literature at the firm-level is the that it is largely focused on case of large firms. Though some studies examine the digitalization and firm

performance or internationalization nexus from small and medium enterprises (SME) perspective, most studies fail to factor in the role of micro firms. In this regard, our study explores the implications of digital adoption for the case of Indian micro firms. Our decision to focus on micro firms in India is driven by certain key factors. First, India is home to 63 million MSMEs which employ close to 111 million workers and contribute 29% of GVA to India's GDP, 40% in manufacturing GVA, and 45% in overall exports.[3] However, of these 63 million MSMEs 99.83% of these firms are micro in nature (Raghuvanshi et al., 2019). In this regard, though the importance of MSMEs in the Indian economy is well recognized, focus of the existing studies is largely on SMEs rather than micro firms largely due to the data availability. Since policy makers are aiming towards 5 trillion economy and the large-scale employment generation potential of these firms, it is crucial to examine factors that aid micro firms performance and internationalization. Therefore, using the recent micro firm survey data from World Bank, we empirically investigate the association between digital adoption of these firms and their performance and export participation.

To preview our findings, we use principal component analysis (PCA) on our 12 parameters of digitalization we develop a digital adoption index and find that higher digital adoption is associated with improved firm sales, labour productivity, and export participation. Furthermore, exploring the heterogeneity of twelve indicators, we find that different digitalization adoption measures impact firm performance and internationalization differently. For instance, On the one hand, we find that use of social media is significantly associated with higher firm performance. On the other hand, we find that digital adoption in terms of purchase and tracking of inputs is a key enabler of export participation for Indian micro firms.

Rest of the paper is structured is as follows. Section 2 presents a detailed review of the existing literature, Section 3 sheds light on the data and methodology employed for the study. Section 4 presents the results, and Section 5 concludes the study.

2. Related Literature

[To be developed]

3. Data & Methodology

3.1 Data

To examine the adoption of digital technologies amongst micro firms and investigate its association on firm performance and internationalization, we use a unique survey-based database sourced from World Bank Enterprise Survey on Micro (ESM) Firms for Indian firms during the year 2022. The survey collected data across nine Indian cities.[4] The firms surveyed are formally registered businesses which are spread across all non-agricultural and non-extractive sectors. Furthermore, firms surveyed are stratified based on their industry affiliation and region. The survey provides key firm-level information on firm sales, exports, imports,

[3] pib.gov.in/PressReleaseIframePage.aspx?PRID=1985020

[4] These cities that were surveyed are Hyderabad; Jaipur; Kochi; Ludhiana; Mumbai; Sehore; Surat; Tezpur; and Varanasi. The survey was done by the World Bank Group's (WBG) Enterprise Analysis Unit in India.

finance, crime, ownership, business environment. Our final sample consist of 836 micro firms spread across 9 cities.

Employing ESM to examine the implications of digital adoption on firm performance and internationalization has some key advantages over other existing database covering Indian firms. First, the ESM collects information on various facets of digital use in firms day-to-day business activities. Survey response to these questions enables us to identify whether a firm has adopted digital measure and how the firm uses these measures. For instance, we are able to identify is firm is using digital means to interact with its customers or using internet to purchase inputs (we discuss more in the variables section). The presence of such information allows to comprehensively capture various uses of digitalization enabling us to examine how heterogenous means of digitalization impacts firm performance. Second, most of the existing database on India are not representative of micro firms. For instance, the World Bank Enterprise Survey rounds or the Prowess database are not representative of micro firms. On the other hand, databases such as National Sample Survey Organization (NSSO) and Fourth All-India Census of MSMEs 2006, do not have intricate detailed information on various use of digitalization by micro firms. Therefore, given these distinct advantages, we use the ESM database for our study.

3.2 Methodology

We investigate the role of digital adoption on firm performance and internationalization using the following parsimonious model as specified in Equation 1.

$$Y_{ic} = \beta_1 Digitalization_{ic} + Z + \epsilon_{ic} \qquad (1)$$

In Equation 1, *i* represents the micro firm in the sample and *c* represents the city from which the firm operates in. **Y** represents firm performance and is the dependent variable for our analysis. To capture firm performance, we use firm sales and firm productivity (output per worker) as performance metric. Where the former captures scale amongst micro firms and the latter sheds light on output per worker across these firms. We use an ordinary least squares (OLS) to estimate equation 1.

Another key aspect of our study is to explore the implications of digital adoption on firm internationalization, specifically, firm export. To this end, we proxy exporting behaviour of the firm using a binary variable that takes the value of 1 if the firm exports and 0 otherwise. Given the binary nature of our dependent variable, we estimate a probit model as specified in equation 2.

$$\Pr(E_{ic} = 1) = \phi(\alpha_1 Digitalization_{ic} + \boldsymbol{Z} + \epsilon_{ic}) \qquad (2)$$

Across both empirical specifications, our main variable of interest is digitalization. Digitalization represents a complex phenomenon that encompasses a multitude of factors

ranging from investment in ICT products, to adoption robots, investment in software among others. Furthermore, digitalization also aims to captures the extent to which firms are able to integration various aspects of digitalization in their production function. In this regard, studies exploring implications of digitalization have tried to capture the phenomenon using various measures which attempts to account various facets of digitalization. For instance, Haller & Siedschlag (2020); and Gopalan et al., (2023) proxy firm digital adoption via their use of website services. The former also uses firms acceptance of online transaction as an additional metric of digital adoption. In a recent study on Indian firms, Reddy & Sasidharan (2023) measure firm digitalization using their expenditure on software development, ICT and ICT-enabled services.

As evidenced, a plethora of studies capture the notion of digitalization differently. More importantly, most of these studies either focus on investment in ICT and related infrastructure or examine limited aspects of adoption such as use of website or email for business interaction. Hence, given the complex nature of digitalization, capturing it using a unidimensional measure may not capture the true essence of digitalization. In this regard, we create a multi-dimensional index that focuses on digital adoption of the firm.

Specifically, WBES provides 12 key parameters related to digital adoption by the firm broadly covering aspects of digitalization used for interaction with customers, for financial access, for day-to-day operations and for supply chain management. Table 1 below details these 12 parameters. From the table we observe that almost 80% of the sample firms use internet, 62% use it for purchase of inputs and for tracking inputs. Further, 37% of the micro firms use social media to interact with their customers. The WBES also provides information on digital adoption from a financial perspective. Specifically, 58% of the firms use digital payments to pay suppliers, and pay utility bills, whereas only 21% of the firms use digital payments for loan repayment. Finally, 43% of the firm use digital payments to pay to its workforce. Using these indicators, we employ a principal component analysis which allows us to create a synthetic index that collapses information on 12 key parameters of digitalization (We discuss PCA analysis in detail in section 4)

Descriptive Statistics

Variable	Description	Obs	Mean	Min	Max
Log Productivity	Ln of output per workers	723	13.179	10.021	17.034
Ln Sales	Log of Sales	814	13.892	10.463	17.728
Export	=1 if Firm Exports	836	.164	0	1
Use Internet	=1 if firm uses internet	836	.804	0	1
Buy Inputs	=1 if firm uses internet to buy inputs	836	.628	0	1
Track Inputs	=1 if firm uses internet to track inputs	836	.629	0	1
Customer Interaction	=1 if firm uses internet to interact with customers	836	.877	0	1
Social media	=1 if firm uses social media	836	.373	0	1
Digital payments	=1 if firm uses digital payments	836	.688	0	1
Pay suppliers	=1 if firm uses digital payments to pay suppliers	836	.58	0	1
To Save	=1 if firm uses digital payments to	836	.541	0	1

	save				
Pay Utility Bills	=1 if firm uses digital payments to pay utility bills	836	.587	0	1
Receive Payment	=1 if firm uses digital payments to receive payments from customers	836	.657	0	1
Pay Loans	=1 if firm uses digital payments to pay loans	836	.213	0	1
Pay Workers	=1 if firm uses digital payments to pay workers and family	836	.439	0	1
Log Age	Log of number of years firm has been in operation	836	2.529	1.099	4.143
Sole	Sole proprietor firm	836	.959	0	1
Female Owned	Female owned firm	836	.055	0	1
Access to finance	=1 if day to day operations are financed from bank	836	.337	0	1
Log SDP	Log of state domestic product	836	16.917	14.139	18.537
Log Tele	Log of telephones per 100 population	836	4.57	4.21	5.452

In both Equations 1 & 2, Z represents a vector of various control variables and fixed effects employed in the estimation. More specifically, at the firm-level, we control for ownership of the firm in terms of with a firm is a sole proprietor firm. In addition, we also account for ownership by the gender of the owner.. To account for firms experience, we control for age of the firm. We also factor in availability of finance from bank for its day-to-day operation. From table 1, we observe that nearly 96% of the micro firms are sole proprietor firms and less than 1% of the sample is owned by female firms. In addition to firm level controls, given that the sample firms are from nine different cities of different states, we control development factors at the state level. Hence, we control for state GDP and the telephone infrastructure in these states. Finally, we include a manufacturing dummy that differentiates between manufacturing and service firms in our sample.

To preserve the maximum sample size, we estimate our equation 2 on a sample of 836 micro-enterprise. However, in terms of firm sales we have consistent information on only 814 firms, which reduces to 723 firms when output per worker is used as dependent variable in estimating equation 1.

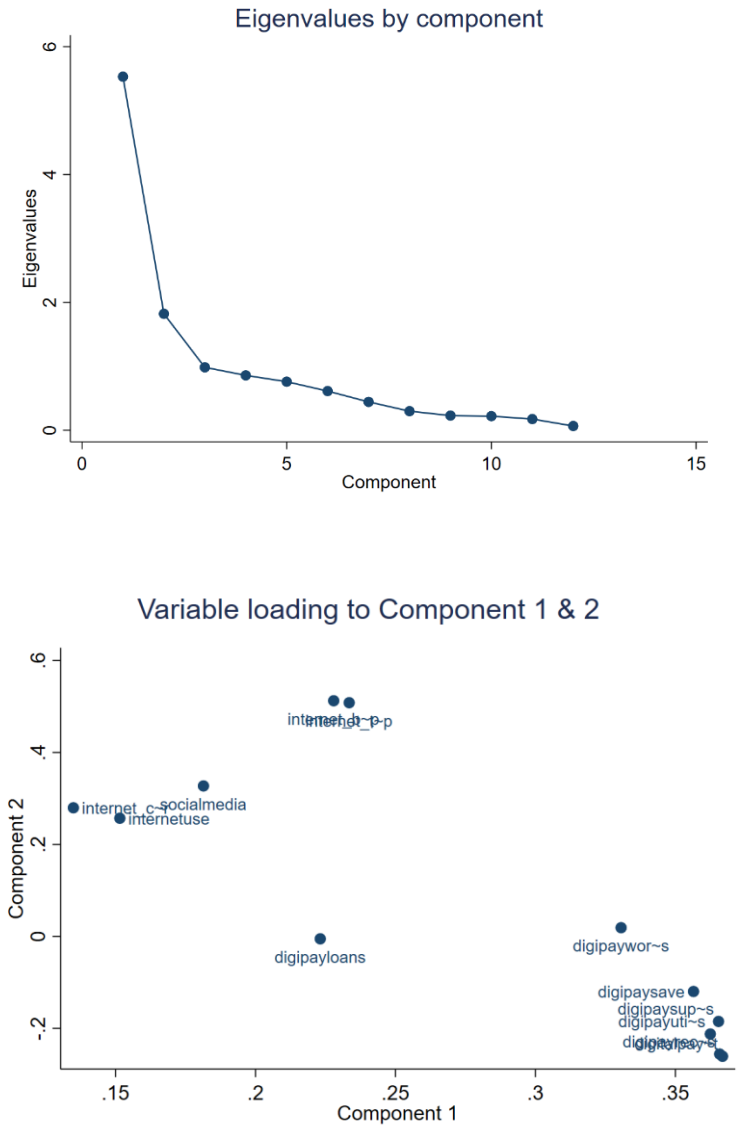
4. Empirical Analysis

4.1 PCA

To capture digitalization, we employ principal component analysis (PCA) which is a data reduction technique employed in the literature to reduce the dimensionality of the dataset (Dunteman, 1989; Vyas & Kumaranayake, 2006). In our context, given that we have 12 parameters capturing various aspects of digitalization, PCA draws information from these parameters and generates factors that are uncorrelated and retains information on the 12 aspects of digitalization in its factors. Hence, while running PCA, we retain principal components that captures the key relevant information from 12 parameters. In this regard, we resort to the Kaiser rule and use components with eigen values greater than 1. In our analysis, first two components

report eigen values greater than 1 (Figure 1) and together explain 61.2% of variation across the 12 parameters. Further, considering that the first two components explain a large share of variation in the data, we examine how these twelve parameters are loaded in these components. From the figure 1, we observe that digital payments related parameters are more prominent in component 2, whereas other uses of internet feature more in component 1.

Figure 1: Eigenvalues and Variable Loadings - PCA



Source: Authors

Next, we run the Kaiser–Meyer–Olkin (KMO) test which is a measure to check the sampling adequacy of the data. Our KMO yields a value of 0.87 highlighting that suitability of the sample for undertaking principal component analysis. Finally, we undertake K-fold cross validation to check whether to use either of the components independently or jointly in our regression analysis. Using the K-fold method, we compute root mean square error for three models where the first model only includes the first component, the second included only the second principal component, and the third model includes both the component. Across the three models, we

observe that the RMSE is the lowest when both components are used. Hence, we make use of both the components generated via PCA for our baseline results.

4.2 Baseline

Table 2 below presents the results of our empirical analysis wherein the dependent variable in Column 1 is firm sales and in Column 2 is firm productivity which are estimated using OLS on equation 1. In Column 3, the dependent variable is exports and given the binary nature is estimates using a probit model as specified in equation 2. From the table, we observe that our two derived PCA components proxying digital adoption of firms yields a positive and significant coefficient across all the three columns. The results indicate that Indian micro firms adopting digitalization experience a performance premium in terms of improved output levels per workers and improvement in overall sales. Furthermore, it also enables enhances exporting potential of the firms. Though, the literature encompassing micro firms is thin, our findings resonate with the literature on small firms that document a positive impact of digitalization on various aspects of firm performance

Table 2: Digital Adoption, Firm Performance, and Exports

	OLS	OLS	Probit
	(1)	(2)	(3)
	Ln Sales	Ln Productivity	Exports
Principal Component-1	**0.089*** **	**0.048*** **	**0.0140** **
	(.015)	(.016)	(0.00575)
Principal Component-2	**0.139*** **	**0.076*** **	**0.0258*** **
	(.024)	(.027)	(0.00955)
Ln Age	.211***	.143**	0.0703***
	(.058)	(.063)	(0.0225)
Sole	-.259	-.349**	-0.00592
	(.164)	(.176)	(0.0623)
Female Owned	-.219	-.045	0.0972*
	(.147)	(.167)	(0.0507)
Access to Finance	.174**	.166**	-0.0325
	(.074)	(.082)	(0.0281)
Ln SGDP	.213***	.207***	-0.0331***
	(.028)	(.029)	(0.00979)
Ln Tele	1.027***	.745***	0.0400
	(.099)	(.111)	(0.0367)
Firm-Level Controls	Yes	Yes	Yes
State-Level Controls	Yes	Yes	Yes
Manufacturing FE	Yes	Yes	Yes
Observations	814	723	836

*Column 3 reports marginal effects. Robust standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1*

4.3 Digitalization Heterogeneity

As mentioned earlier, digitalization is a complex phenomenon encompassing a multitude of factors. In this regard, Cavoli et al. (2018) note that digital transformation is not limited to investing in the most advanced digital tools but also using digital means for interacting with

businesses and customers. In this regard, we leverage the richness of our unique database and examine how each of the 12 parameters of digitalization impacts firm performance. Table 3 presents the results of our estimation of equation 1 with firm sales as the dependent variable. From the table we observe that all the 12 parameters of digitalization yield a statistically significant coefficient highlight that digital adoption is a key driver of sales for micro firms. In terms of magnitude, we observe that use of social media to interact with customers yields the highest increase in firm sales, followed by use of internet in general and for purchase and tracking of inputs.

In table 4, we present the result of our analysis with firm output per worker i.e., productivity as the dependent variable. From the table, we observe that use of internet in general, and use of digital payments have a positive impact on output per worker. However, a detailed look highlights that use of internet for customer interaction and social media engagement results in productivity improvement. This is line with our earlier finding of expansion in firm sales, which in turn would result in higher output per worker for the firm. Furthermore, firms that use digital payments to save, to receive money, and to pay their utility bills, and workers are experiencing productivity enhancing effects.

Finally, in table 5, we document the marginal effects of our estimation of equation 2, with export as the dependent variable. From the table we note that, only five out of 12 parameters are significantly associated with enabling export participation of micro firms. Interestingly, the significant coefficients are, use of internet for purchase and tracking of inputs, and digital payments to suppliers and workers. All these represent aspects that results in operational efficiency for the firm which are pivotal for export integration. We also note that use of internet for customer interaction results in greater export participation, however, social media interaction does not yield a significant coefficient deviating from the results reported for firm performance. This guides us to believe that social media as a mode of interaction with customers is a key strategy for domestic market, however, this does not yield results from exporting perspective.

Table 3: Digital Adoption and Firm Sales

	(1) Log sales	(2) Log sales	(3) Log sales	(4) Log sales	(5) Log sales	(6) Log sales	(7) Log sales	(8) Log sales	(9) Log sales	(10) Log sales	(11) Log sales	(12) Log sales
Internet Use	.528***											
	(.078)											
Buy Input		.352***										
		(.068)										
Track Input			.397***									
			(.068)									
Customer Interaction				.234**								
				(.093)								
Social Media					.589***							
					(.07)							
Digital Payment						.21***						
						(.074)						
Payment to Suppliers							.175**					
							(.07)					
Save								.334***				
								(.068)				
Utility Bills									.212***			
									(.069)			
Receive Payments										.23***		
										(.072)		
Pay Loans											.182**	
											(.089)	
Pay Workers												.369***
												(.072)
Firm-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Manufacturing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	.228	.214	.221	.195	.258	.198	.196	.213	.199	.2	.194	.217
Observations	814	814	814	814	814	814	814	814	814	814	814	814

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

Table 4: Digital Adoption and Firm Productivity

	(1) Log Productivity	(2) Log Productivity	(3) Log Productivity	(4) Log Productivity	(5) Log Productivity	(6) Log Productivity	(7) Log Productivity	(8) Log Productivity	(9) Log Productivity	(10) Log Productivity	(11) Log Productivity	(12) Log Productivity
Internet Use	.316***											
	(.091)											
Buy Input		.126*										
		(.074)										
Track Input			.107									
			(.075)									
Customer Interaction				.305***								
				(.092)								
Social Media					.458***							
					(.073)							
Digital Payment						.115						
						(.079)						
Payment to Suppliers							.063					
							(.074)					
Save								.187***				
								(.072)				
Utility Bills									.122*			
									(.073)			
Receive Payments										.157**		
										(.077)		
Pay Loans											-.02	
											(.091)	
Pay Workers												.142*
												(.076)
Firm-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Manufacturing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	.136	.125	.124	.131	.168	.124	.123	.13	.125	.127	.122	.126
Observations	723	723	723	723	723	723	723	723	723	723	723	723

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

Table 5: Digital Adoption and Export participation

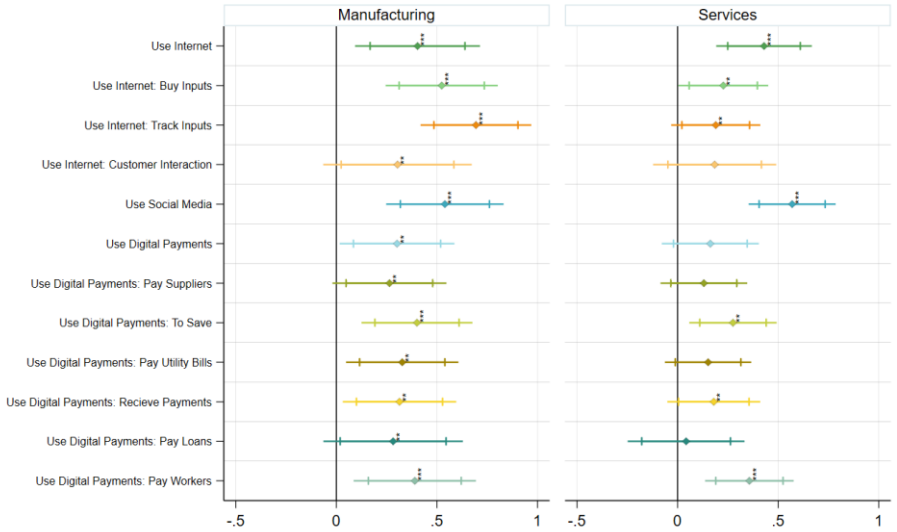
VARIABLES	(1) Export	(2) Export	(3) Export	(4) Export	(5) Export	(6) Export	(7) Export	(8) Export	(9) Export	(10) Export	(11) Export	(12) Export
Internet Use	0.0983											
	(0.143)											
Buy Input		0.360***										
		(0.119)										
Track Input			0.451***									
			(0.121)									
Customer Interaction				0.361**								
				(0.183)								
Social Media					0.152							
					(0.115)							
Digital Payment						0.0705						
						(0.117)						
Payment to Suppliers							0.212*					
							(0.114)					
Save								0.0131				
								(0.112)				
Utility Bills									0.133			
									(0.113)			
Receive Payments										0.0494		
										(0.114)		
Pay Loans											0.216	
											(0.138)	
Pay Workers												0.348***
												(0.114)
Firm-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Manufacturing FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	836	836	836	836	836	836	836	836	836	836	836	836

All columns report marginal effects. Robust standard errors in parentheses

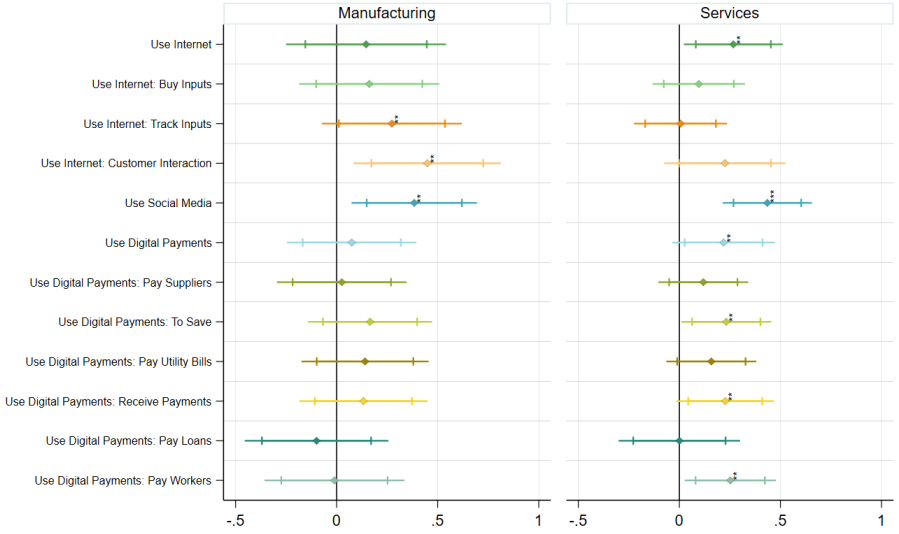
*** p<0.01, ** p<0.05, * p<0.1

4.4 Manufacturing v Services

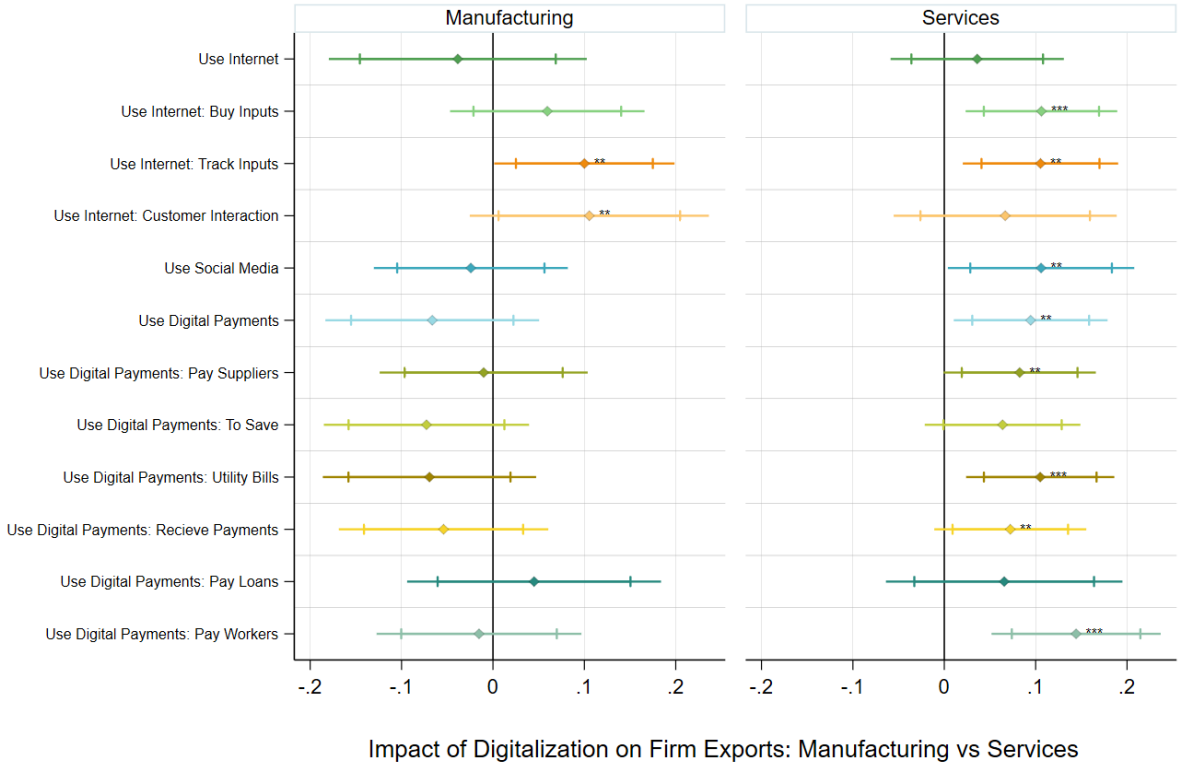
A key feature of our sample is that it encompasses firms from manufacturing and services sector. To this end, we re-estimate Equation 1 & 2 separately for manufacturing and services firms to examine whether digital adoption parameters used in our analysis have a homogeneous or heterogenous effect on firm sales, productivity, and internationalization. Figure 2 presents the coefficient plot. From Panel A (Figure 2), we observe that in terms of firm sales, digital adoption plays a more prominent role for manufacturing firms as evidenced by the positive and significant coefficient on all 12 parameters of digitalization. In contrast, efficiency of a firm based on its sales per worker is more receptive to digital adoption measure for service firms compared to that of manufacturing firms. In a similar vein, we also observe that digitalization measures are relatively more important for service exports by micro firms as opposed to that of manufacturing firms [To be developed further]



Impact of Digitalization on Firm Sales: Manufacturing vs Services



Impact of Digitalization on Firm Productivity: Manufacturing vs Services



Impact of Digitalization on Firm Exports: Manufacturing vs Services

5. Conclusion

Over the past two decades, and especially post the on-set of the Covid-19 pandemic, digitalization has brought about a paradigm shift in the way firm operates. In this regard, existing literature documents the importance of digitalization proxied by firm's investment in ICT results in improving firm performance and enables trade integration. However, how digital adoption especially digital payment systems influences firm performance and trade participation is yet to be explored. More so, from a micro firms perspective, which has not received sufficient attention in the burgeoning literature. In this regard, drawing from a unique survey database, and identifying 12 parameters of digital adoption, we find that digital adoption is significantly associated with improvement in firm sales, output per worker, and increases the probability of firms export participation. Furthermore, customer interaction, especially social media engagement is key for improving firm sales, and productivity. However, use of digitalization for efficiency in purchase of inputs, tracking of inputs and payment to suppliers results in higher exporting probability for a firm. [To be further developed]

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