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Drivers of ICT Adoption in Small and Very Small Businesses in Technologically Least Developed District of Southern Punjab

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Abstract

The study examines the extent of ICT adoption and to determine the effects of technological competencies and human capital on the adoption of ICT among small and medium enterprises (SMEs) in Southern Punjab, Pakistan. We collected cross-sectional data from 170 firms. The ordered probit model was employed. ICT adoption includes ICT intentions, ICT infrastructure, internet integration, e-sales, and e-procurement. Results showed that research collaboration was the only variable having a significant and positive effect on all ICT adoption measures. This implied that investment in research collaboration by the firms could lead to an increase in ICT adoption. The study also found that research and development were significantly related to ICT infrastructure, e-sales, and e-procurement. Results also suggest that the firms need to enhance their R&D activities, innovations, and research collaborations to increase their ICT intentions. The latter two should also be emphasized to promote internet integration in firms.

Disciplinary: Business Management (SME) and Information Technology.

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1. Introduction

The performance of organizations and businesses has improved as a result of the adoption of the advancement in data and telecommunication as compared to the manual systems (Shiels et al., 2003). In the presence of a competitive market environment, very small and small businesses are making arrangements for ICT adoption to contend with the rivals and attract customers. Key factors of ICT adoption among SMEs include structure innovation, analysis and development activities, analysis collaboration, personnel with ICT skills, and decentralized decision-making process. Such factors have greater implications for the very small and small businesses operating in a dynamic atmosphere. Some of the benefits of ICT adoption include a reduction in operation prices, an increase in client satisfaction, and market share, and an improvement in employee performance (Buhalis & Main, 1998; Karadag et al., 2009). The adoption of ICT helps businesses to enhance business activities expeditiously and effectively. Some examples include storing, dispensing, spreading, communication, retaining of data (Ongori & Migiro, 2010), addressing challenges of dynamic atmosphere and operation efficiency (Spanos et al., 2002).

Adoption of ICT in very small and small businesses is associated with changes in price effective production, firm potency, effective chain management, and sound business opportunities (Fulantelli & Allegra, 2003; Ghobakhloo et al., 2011; Ongori & Migiro, 2010). Now the question arises what are possible barriers hindering ICT adoption among the very small and small businesses. The required investment, motivation, and lack of trained staff, obtaining license, amendment in the business surroundings, and infrastructure at the firm level are cited as possible barriers to ICT adoption (Ghobakhloo et al., 2011; Tan et al., 2010). Such problems become more prevalent in developing countries where there is limited availability of skilled and trained personnel and small family firms dominate.

Very small and small businesses in Pakistan like other developing countries are facing challenges of ever-increasing competition as the world has become a global village in the present era. For surviving in a dynamic competitive environment, businesses have started diverting attention towards the adoption of ICT to provide e-services and enhance production and productivity. Further, ICT adoption heavily depends on economic and political stability (Amit and Zott (2001) because the businesses need huge initial investment for infrastructure, culture diversity, and entrepreneurial activity (Erumban & De Jong, 2006). Despite fiber cable reaching the least developed countries (Kilangi, 2012), ICT acceptance and its application in developing countries is further restricted only to email services and websites (Goldstein and O'connor (2000). Houghton and Winklhofer (2004) argue that acceptance of ICT by SMEs is still in the infancy stage in developing countries. Kapurubandara and Lawson (2006) cited internal and external barriers to the introduction of ICT in SMEs. Internal barriers include proprietary manager characteristics, strong performance, and value for money. Infrastructure, social, cultural, political, and legal aspects are considered as external factors.

Pakistan presents a typical case for the adoption of ICT by very small and small businesses. These businesses dominate the economy with limited human capital and technological competencies. Further, businesses are mostly managed and operated by family members. Such businesses can survive in the rising competitive environment by adopting new technologies. One finds huge literature on ICT adoption in developed countries. We find very limited research work on ICT adoption and its determinants among very small and small businesses operating in developing countries. Traditional, cultural values and capital of the businesses in developing countries are hugely different from those of developed nations. The present study is designed to see the extent of ICT adoption among very small and small businesses and the effects of firm and firm-owner-related characteristics on the extent of ICT adoption in the less developed part of Southern Punjab,

Pakistan. The importance of this study lies in the fact that small enterprises can gain a competitive advantage through ICT adoption. Findings would also be useful for the government officials and SMEs policymakers to develop the strategies and sustainability of SMEs. We measured the role of the firm competencies and workforce capacity in ICT adoption. Five dimensions are considered including ICT intentions, ICT infrastructure, E-sales, E-procurement, and integration.

The study is based on the technology adoption model. This model is widely used in studying adoption factors affecting ICT (Shaikh & Karjaluoto, 2015). Technological competencies and the human capital of firms are important in ICT adoption. Technological competencies include organizational innovations, research and development activities, and research collaboration. Organizational innovation means examining and analyzing ICT innovation, resources owned by firms, and the effects of ICT on firms (Brynjolfsson & Saunders, 2010; Hammer & Champy, 1993; Lyytinen & Newman, 2008). Organizational innovation provides firms an edge against competing firms in the market as a result of efficient management of production processes, service provision, and feedback from the users of the services and or products. Similarly, research and development activities enable firms in adopting new technologies and this is true for ICT use in production processes. Research and development activities tend to produce innovations, improving firms' capability to isolate, integrate, and expand activities to a wider level. Further research and development activities foster opportunities for a variety of learning instead of learning by doing. Research collaboration is another important component of technological competencies with an important role in ICT adoption. Bjerregaard (2010) argued that cultural variation and communication could hamper the general production of information about knowledge data and cooperation. The importance of collaboration needs to be boosted in the area of personal information management. Research collaboration can provide improved variation of capital, abilities, information, and perspectives (Hannigan & Curran, 2008). As noted by (Giotopoulos et al., 2017), there exists a positive relationship between technological competencies and ICT adoption. Thus, the first hypothesis of the study is

H#1: A firm's technological competency is positively associated with ICT adoption.

Another aspect of the study is the effect of human capital on ICT adoption among SMEs. Human capital includes personnel with scientific background and personnel with ICT skills. Firms with highly scientific personnel are highly probable to possess a higher level of technology (Bartel & Sicherman, 1999). Personnel with scientific skills promote the use and adoption of ICT in the organization (Arvanitis, 2005; Bayo-Moriones & Lera-López, 2007; Fabiani et al., 2005). Similarly, firms with personnel having ICT skills have a greater tendency of ICT adoption. Bharadwaj (2000) showed that firms having permanent ICT employees have a competitive edge over other firms through turnover and cost-established procedures and realizing the economic benefits of ICT adoption. Thus, we assume that human capital entrenched in the employees of SMEs has a significant impact on the adoption procedure and exploitation of ICT. Based on these facts, our second hypothesis is

H#2: A skilled workforce with a scientific background is positively associated with ICT adoption.

2. Material and Methods

2.1 Data and Source

This study is different from the previous studies because those studies were conducted in developed countries. Development level, infrastructure, human capital, organizational competencies, tradition, and customs in the developed countries are substantially different and are present in improved and advanced form compared to the developing countries. Further, the present

study has focused on the southern part of Punjab province of Pakistan and this part of Pakistan is least developed compared to northern and central Punjab of Pakistan.

This study purposively selected Vehari District of southern Punjab. Vehari is characterized by dominant agro-based industries. Vehari chamber of commerce and industry (VCCI), established a few years ago, is making efforts to boost business activities in the district through providing training to small entrepreneurs and building contacts of small entrepreneurs with established chambers of commerce and industry in the province to provide exposure to successful businesses. A total of 315 firms are registered with VCCI. From the obtained list of business firms registered with VCCI, 175 very small and small firms were selected randomly.

Well-prepared and pre-tested questionnaires were used. Each variable contained a different number of items. The items were close-ended questions with options for the managers and owners of very small and small businesses to choose as many options as were applicable. The cross-sectional data were collected through a structured questionnaire divided into four sections namely the firm's internal industry, human capital, and use of ICT and innovation activities. We received 170 questionnaires completed in all the respects, giving a response rate of 97%.

2.2 Empirical Methods

Descriptive statistics are used to examine the characteristics of the selected firms. In ICT adoption, we considered ICT intentions, ICT infrastructure, internet integration, E-sales, and E-procurement. By ICT intentions, we mean the degree to which the firm has applied or proposes to apply activities required for starting ICT. ICT infrastructure shows the number of ICT assets possessed by SMEs. ICT assets comprise information on resource management system, information systems manager, computer room, and security back up plan for information systems. The amount of a firm's resources that are maintained by the application of the Internet is known as internet integration. This variable explains the number of tasks performed by using the Internet. E-sales variable is defined as the ratio of on-line selling to the total turnover. E-procurement is the proportion of electric earning to entire earning. Likert scale was used to obtain information from the respondents. Since the response is in ordered form, we employed an ordered probit model to examine the effect of technological competencies, human capital, and control variables on ICT adoption. Five ordered probit models were run one for each ICT adoption measure.

Equation (1) was used for ICT acceptance.

$$\text{ICT Adoption} = \beta_1 \text{TechComp}_i + \beta_2 \text{HumCap}_i + \beta_3 Z_i + \varepsilon_i \quad (1).$$

TechComp_i shows the technological competencies of the selected firms, HumCap_i denotes the human capital features of the selected SMEs, Z_i represents control variables and ε_i is the random error term assumed to be normally distributed. β_1, β_2, and, β_3 denote the marginal effects of variables to be estimated.

3. Results and Discussion

Table 1, 170 firms were surveyed; only 18.2% of firms are in manufacturing industries. Of these, 6.4% belong to the very small business size category, whereas 32.9% of them are from the small business size category. Merely 29.4% of firms are in services industries. Of these, 39.4% belong to the very small business size category, whereas 17.1% of them are from the small business size category. 52.4% of firms are in the trading industries. Of these, 54.3% belong to the very small business size category, where 50% of them are the small business size category. The majority of the firms were 5-15 years old. Around 79% of very small firms were located in Vehari city while 63% of small businesses were doing business activities outside Vehari city.

Table 1: Summary statistics.

Firm Size	Very small Business	Small Business	Total
Firm industry			
Manufacturing	6 (6.4)	25 (32.9)	31 (18.2)
Services	37 (39.4)	13 (17.1)	50 (29.4)
Trading	51 (54.3)	38 (50)	89 (52.4)
Firm location			
Vehari city	74 (78.7)	28 (36.8)	102 (60)
Outside Vehari city	20 (21.3)	48 (63.2)	68 (40)
Distance from Vehari			
Less than 5 km	5 (25)	5 (10.4)	10 (14.7)
5 to 15 km	6 (30)	16 (33.3)	22 (32.4)
16 to 30 km	3 (15)	10 (20.8)	13 (19.1)
More than 30 km	3 (30)	17 (35.4)	23 (33.8)
Firm age			
Less than 5 years	15 (16)	7 (9.2)	22 (12.9)
5 to 15 years	47 (50)	38 (50)	85 (50)
16 to 30 years	29 (30.9)	26 (34.2)	55 (32.4)
More than 30 years	3 (3.2)	5 (6.6)	8 (4.7)

Note: Figures in parentheses are percentages

Table 2 provides information on ICT adoption. We found that firms do not attempt to adopt new ICTs were 26.5%. 30.9% of such firms were from very small business size type, whereas 21.1% of firms were small business size type. Merely 48.2% of firms carried out limited efforts to adopt new ICTs. Only 20% of firms were found undertaking significant efforts to adopt new ICTs. Of these, 16% were very small business size type and 25% small business size category. Only 5.3% of firms adopted new ICTs immediately prior to competitors. Considering the integrated resource management information system, only 11.9% of firms were found with integrated resource management information systems out of 170 firms. Of these, 8.51% were very small business firms, and 21.1% small businesses. Merely 8.5% of firms had the services of a dedicated information system manager. Out of the total firms surveyed, only 34.3% of firms were found to have a computer room. While the very small firm and small firms with computer rooms were 33% and 50% respectively. The respective percentage of installed information system security and risk assurance plan was 16% and 39.5%. Very small and small firms with no ICT infrastructure were 36.2% and 15.8% respectively. The percentage of the firms using the Internet for finding the information was only 41.1% and 32.3% of firms using the Internet for e-mail. Only 7% of the total selected firms used the internet for banking transactions. The firms using the Internet for ordering was only 9.2% whereas 10.4% of firms had no internet integration. Of the surveyed 170 firms, 82.9% firms were

found not selling products through Internet, 82.9% firms did not place orders via the Internet and this percentage was higher for very small business firms (Table 2).

Table 2: Description of firms with regard to ICT adoption

Firm Size	Very small Business	Small Business	Total
ICT intentions			
To what extent the firm has an orientation to adopt new ICTs?			
There is no attempt	29 (30.9)	16 (21.1)	45 (27)
Limited efforts	47 (50)	35 (46.1)	82 (48)
Significant efforts	15 (16)	19 (25)	34 (20)
Immediately prior to competitors	3 (3.2)	6 (7.9)	9 (5)
ICT infrastructure			
To what extent the ICT resource has been installed by the firm?			
Integrated resources management information	8 (8.51)	16 (21.1)	24 (12)
Information system manager	3 (3.2)	14 (18.4)	17 (9)
Computer room	31 (33)	38 (50)	69 (34)
Information system security & risk assurance	15 (16)	30 (39.5)	45 (22)
None	34 (36.2)	12 (15.8)	46 (23)
Internet integration			
In how many business functions the firm makes use of the internet?			
Finding information	67 (71.3)	63 (82.9)	130 (41)
E-mail	49 (52.1)	53 (69.7)	102 (32)
Banking transactions	12 (12.8)	10 (13.2)	22 (7.0)
Conduct of ordering	14 (14.9)	15 (19.7)	29 (9.2)
None	22 (23.4)	11 (14.5)	33 (10)
E-sales			
To what extent the company sells products through the internet?			
0%	87 (92.6)	54 (71.1)	141 (83)
1% - 30%	3 (3.2)	12 (15.8)	15 (8.8)
31% - 60%	3 (3.2)	5 (6.6)	8 (4.7)
61% - 100%	1 (1.1)	5 (6.6)	6 (3.5)
E-procurement			
To what extent the company sets orders via the internet?			
0%	83 (88.3)	58 (76.3)	141 (83)
1% - 30%	7 (7.4)	9 (11.8)	16 (9)
31% - 60%	3 (3.2)	6 (7.9)	9 (5)
61% - 100%	1 (1.1)	3 (3.9)	4 (2)

Note: Figures in parentheses are percentages

3.1 Determinants of ICT adoption

Table 3 shows the estimates of the ordered Logit model. We found that organizational innovations and R&D activities had a positive and significant effect on the probability of ICT intentions. Research collaborations variable was also positive and significantly related to ICT intentions. These results are consistent with the previous studies (Alshamaila, et al., 2013; Arvanitis & Hollenstein, 2001; Giotopoulos et al., 2017; Hollenstein, 2004). Personnel with scientific background variables were insignificant for ICT intentions, whereas personnel with ICT skills were negative and significant. This seems surprising. However, one possible explanation for these results is brought forward by Macgregor and McCulloch (2006) that small businesses are unwilling to adopt ICT because they consider it complex. Firm size was negative and significant. Higher the firm size, the lower the probability of ICT intentions. Bayo-Moriones and Lera-López (2007) also found that firm size negatively affects ICT adoption. Irefin, et al., (2012) found the same relationship as well. Firms involved in the services sector were found with lower ICT intentions compared to firms in the manufacturing sector. Firm location negatively and significantly affected the ICT intentions of the firms.

Considering ICT infrastructure, we found that organizational innovation was negatively related to ICT infrastructure and statistically different from zero. This finding is in agreement with Rowe, et al., (2012). The coefficient of research collaborations was positive and statistically significant. Giunta and Trivieri (2007)also found a positive effect of research collaboration on ICT adoption. Firms in the services and trading sectors were found to have a higher probability of possessing ICT infrastructure than the firms in the manufacturing sector (Table 3).

Table 3: Results of the marginal effects of the ordered Logit Model.

	ICT intentions	ICT infrastructure	Internet integration	E-sales	E-procurement
Firm Size	-0.47* (0.24)	0.43 (0.31)	0.19 (0.23)	0.54* (0.33)	0.20 (0.38)
Service	-0.74* (0.35)	1.38* (0.53)	0.05 (0.33)	-0.73 (0.48)	5.51 (327.35)
Trading	-0.43 (0.37)	1.04* (0.53)	-0.71* (0.33)	-0.71 (0.47)	5.34 (327.35)
Firm Location	-0.49* (0.25)	-0.18 (0.31)	-0.59* (0.24)	-0.40 (0.34)	-0.57 (0.36)
Firm Age	-0.13 (0.13)	-0.13 (0.17)	-0.20 (0.13)	-0.34* (0.20)	0.25 (0.20)
Organizational innovations	0.83* (0.12)	-0.30* (0.19)	0.44* (0.11)	0.04 (0.08)	0.15 (0.10)
R&D Activities	0.65* (0.17)	0.13 (0.22)	0.25 (0.16)	-0.02 (0.21)	-0.03 (0.27)
Research Collaborations	0.17* (0.08)	0.21* (0.09)	0.12* (0.07)	0.59* (0.17)	0.59* (0.18)
Personnel with scientific background	0.12 (0.10)	0.10 (0.15)	-0.22* (0.10)	0.12 (0.14)	-0.00 (0.16)
Personnel with ICT skills	-0.31* (0.10)	-0.22 (0.15)	-0.16* (0.09)	-0.32* (0.15)	-0.25 (0.16)
Log likelihood	-140.644	-71.5973	-157.664	-87.6422	-80.3898
LR chi^2	120.24	28.28	81.52	39.32	50.48
Number of observations	170	170	170	170	170

Notes: Standard errors are reported in parentheses, *Significant at the 10% level.

Variable namely research collaboration was found statistically different from zero and positively related to ICT internet integration. These results are consistent with many studies (Alshamaila et al., 2013; Arvanitis & Hollenstein, 2001; Giotopoulos et al., 2017; Hollenstein, 2004). Personnel with scientific background and personnel with ICT skills variables were negative and statistically significant. This seemingly appears unexpected. Though one likely reason for these consequences is taken forward by Macgregor and McCulloch (2006) who argue that small businesses are unwilling to adopt ICT because of assuming ICT as complex in nature. The location of firms was significantly and negatively associated with internet integration (Table 3). The plausible explanation for this phenomenon is that internet facilities are not available in the rural areas of the district Vehari. This result is supported by Giotopoulos et al. (2017) who found that firms located in the urban center are more likely with Internet integration.

Research collaboration, personnel with ICT skills, firm size, and firm age were statistically different from zero while considering e-sales (Table 3). The finding of research collaboration is in agreement with Giunta and Trivieri (2007) who find a positive influence of research collaboration on ICT adoption. Positively significantly related firm size with e-sales is supported by Giunta and Trivieri (2007) who find that large firm size increases the probability of ICT adoption. Rowe et al., (2012) also found a positive effect of the size of the enterprise on e-commerce adoption. Large businesses own more financial and human resources and are more mature there for such firms are more likely to adopt ICT than small businesses (Dutta and Coury 2002; Irefin et al., 2012). The negative coefficient of firm age implies that the higher age of the firms lowers the e-sales because

the experienced firms learn that their customers mainly from Vehari district do not use and order their purchases through Internet, therefore such firms shift their focus from e-sales.

Regarding e-procurement, we found that only research collaborations were significantly related and all other factors were not significant. This finding is in agreement with (Giunta and Trivieri 2007). For the least developed district such as Vehari, e-procurement is not popular among the firms mainly due to following dominantly traditional practices, lack of awareness, and absence of ICT infrastructure

4. Conclusion

This study examines the extent of ICT adoption and to check the impact of technological competencies and human capital on the adoption of ICT among Vehari 170 SMEs, empirically analyzed through an ordered probit model which highlights the significance of observed aspects for ICT adoption by SMEs. From the findings, H#1 was supported whereas H#2 was not supported. However, the probability of ICT adoption is greater in those SMEs which are involved in R&D, innovation activities, and research collaboration. Firm size, firm age, firm location, and firm industry were used as control variables. The study results suggested that the extent of ICT adoption was low among Vehari SMEs. Organizational innovation positively affected ICT intentions and internet integration, whereas its effects on ICT infrastructure were negative. As e-sales and e-procurement were concerned, the impact of organizational innovation on these two was statistically insignificant. R&D activities only affected ICT intentions positively and remained insignificant in all other models. Findings also revealed that research collaboration was found to have a significant positive effect on all the sub-variables of ICT adoption thus research collaboration positively influences ICT adoption. Personnel with scientific background only negatively impact Internet integration whereas it was insignificant in all other models. Personnel with ICT skills have a negative impact on ICT intentions, Internet integration, and e-sales. However, its effects on ICT infrastructure and e-procurement were insignificant. In reality, the maximum of the SMEs has a deficiency of time, knowledge, and expertise to efficiently employ e-business strategy supporting agendas, meanwhile very small and small businesses do not have a similar means to adopt tangible ICT policies as their larger counterparts.

5. Availability of Data and Material

Information can be made available by contacting the corresponding author.

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