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DIGITAL DIVIDE IN PAKISTAN: BARRIERS TO ICT ADOPTION

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ABSTRACT

This study aims to analyse the impact of various socioeconomic, regional, and demographic factors on the digital divide in Pakistan. The digital divide refers to the disparity in individual's access to mobile devices and internet-enabled mobile technology. The study uses the Pakistan Social and Living Standard Measurement (PSLM) survey collected in 2019-20. The estimates of the Multinomial Logit model suggest that a lack of gender parity is a potential source of the digital divide. Higher education is associated with greater access to internet-enabled mobile devices. Moreover, being employed increases the likelihood of digital inclusion. It is worth noting that the urban-rural gap and provincial disparity also contribute to the digital divide. Higher household income and wages of individual is also increase the likelihood of digital inclusion. On the other hand, age plays a significant role in determining the digital divide among individuals. Younger individuals are more likely to be digitally included than older individuals, primarily due to differences in self-efficacy. The study also explores various employment statuses as potential contributors to the digital divide among individuals. The study identified marginalised users and proposed measures that need to be undertaken to digitally include these individuals.

KEYWORDS: digital divide, demographic factors, regional, Pakistan

1. INTRODUCTION

The digital divide concept pertains to the discrepancy in the access and utilisation of technological resources. In a broader context, the technological resources comprise the mobile, laptop, personal computer and internet, categorised as focal technology. The digital divide appears across diverse segments of society, encompassing individuals, households, enterprises, and geographical regions, which can be identified by varying socioeconomic groups. The digital divide can also be attributed to the lack of access to information technology (IT) infrastructure, encompassing computers and internet connectivity, within the boundaries of one's residence, educational institution, or professional environment (Wei et al., 2011; Audi et al., 2022). The digital divide has been classified into three distinct levels. The first level of the digital divide is characterised by the challenge of access to the internet and a range of information and communication technologies (ICT). It primarily focuses on the individuals who possess internet access and those who do not. The second level of the digital divide pertains to disparities in the usage, capabilities and skills related to digital resources. The third level of the digital divide pertains to the implications experienced in the real world. For instance, using the internet for personal gain encompasses various domains such as health, social relationships, and business.

The adoption and utilisation of hardware and software for communication and information sharing are called Information and Communication Technology (ICT). The impact of digital technologies and the rise of the digital economy on the progress of societies and economies has been widely acknowledged. The recognition of the importance of information and communication technologies (ICT) in achieving universal identification, efficient governance, financial inclusion, and job creation has been emphasised by the United Nations' Sustainable Development Goals (Georgieva, 2019). These areas are considered essential for the overall progress and advancement of societies. The digital technologies that exhibit the greatest potential for attaining these objectives are mobile phones and the internet, given their notable growth in recent years. According to the SDGs, specifically Target 9.c of SDG 9, there is a growing emphasis on ensuring equitable access to digital technology across all segments of society and geographical regions. Among the 169 targets outlined in the SDGs, three targets, namely 5.b, 9.c, and 17.b, pertain directly to the utilisation and availability of ICT.

The significance of digital devices must be considered, particularly concerning the widespread adoption and usage of mobile phones, which has exhibited an apparent trajectory over the past two decades. In 2001, the mobile phone subscription rate was 18 per 100 individuals globally (see Figure 1). However, this rate has significantly increased and currently exceeds 108 per 100 individuals globally. The observed phenomenon of a similar trend is also evident in low and middle-income

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economies. Nevertheless, it is noteworthy that Pakistan is not exhibiting a surprising trajectory in terms of the penetration of mobile phone usage. In the year 2022, it is observed that the mobile phone subscription rate in Pakistan stands at 80 subscriptions per 100 individuals. This figure indicates a lower level of mobile phone penetration compared to both the global average and the mobile phone subscription rates observed in low and middle-income countries. The lower level of penetration not only impacts the overall welfare of individuals and has significant consequences for the developmental path. Hence, this phenomenon has drawn significant attention, prompting an investigation into the digital divide at the first level among individuals in Pakistan and the potential factors that contribute to this divide.

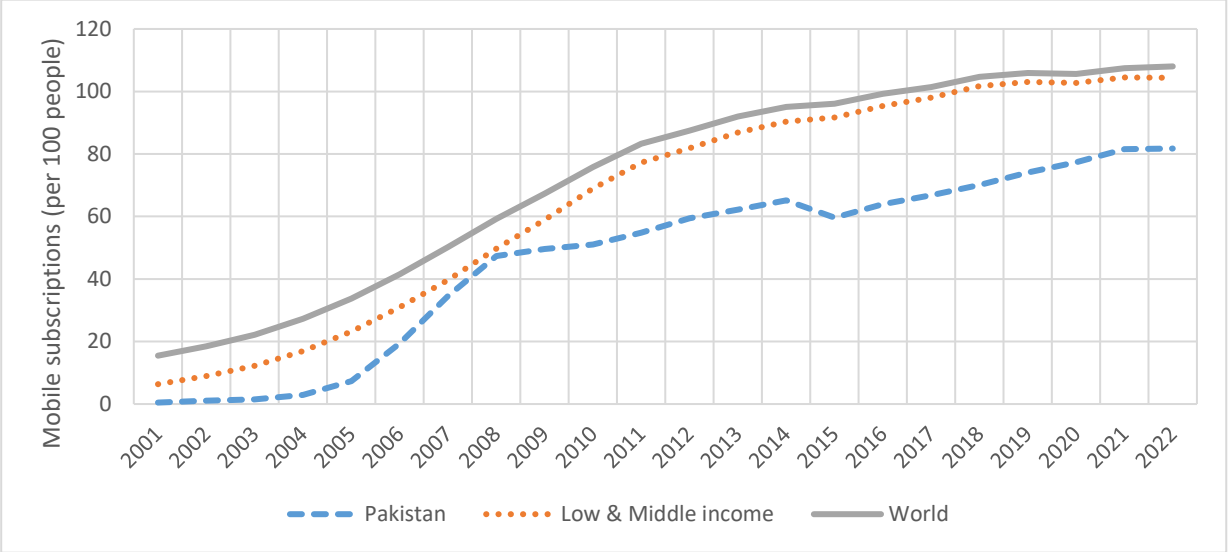

Figure 1. Dynamic pattern of mobile phone subscription

The government of Pakistan demonstrates an ongoing dedication to bridging the digital divide among its people and enhancing the capabilities of individuals through the provision of digital technology. To address the specific objectives, the government of Pakistan initiated the implementation of two key initiatives, namely the Digital Pakistan Vision and the Rolling Spectrum Strategy policy. The Digital Pakistan Vision was introduced in December 2019 to leverage technological advancements to enhance various sectors within the country. Additionally, the Rolling Spectrum Strategy policy, from 2020 to 2023, focuses on using 5G technology, as outlined by the Pakistan Telecommunication Authority. These initiatives have been designed to drive Pakistan's digital landscape forward and foster socio-economic growth. The primary objectives of these policies revolve around improving the functioning of the knowledge-based economy through the swift advancement of the digital ecosystem. In addition, it is worth noting that the government has implemented specific initiatives to provide citizens with digital services. These programmes encompass a wide range of sectors, including but not limited to land records, tax returns, e-governance, education, health, finance, and justice.

The impact of ICT on economic growth in emerging economies has been widely recognised at the macro level. However, there needs to be more focus on the effects of ICT adoption at the individual level within these economies. Based on the available literature, the study conducted by Abdullah (2015) and Jamil (2020) pertains to digitalisation in Pakistan. The study conducted by Shair et al. (2022) is the sole existing study that is relevant to our research. However, their study primarily focuses on the assessment of ICT usage capabilities and does not go into the examination of the first-level digital divide. The present investigation aims to address this void by utilising the nationally representative dataset of the Pakistan Social and Living Standard Measurement (PSLM) 2019-20. The present study aims to assess the impact of various socioeconomic, demographic, regional, and personal factors on digital disparities in Pakistan. Specifically, we seek to estimate the influence of these factors on individuals' access to mobile phones, the internet, and both. The findings of this study will contribute valuable insights within the framework of Pakistan's Vision 2025, which pertains to the ongoing efforts to achieve the status of a developed nation. The adoption of ICT plays a significant role in Pakistan's strategic vision for the years 2025 and 2035-2047. This vision aims to elevate Pakistan's economic status to an upper-middle-income country, ranking among the top 25 global economies by 2025 and, subsequently, to a high-income country, ranking among the top 10 global economies by 2047. Vision 2025 outlined the importance of transitioning to a knowledge economy to achieve the objective. For this purpose, the role of penetration of digital technology among individuals is inescapable. Hence, evaluating the various factors that could contribute to bridging the digital divide is imperative.

The emergence of the digital economy and the rapid advancement of digital technologies have unambiguously brought about significant improvements in global accessibility and connectivity. These developments have profoundly influenced the overall well-being of societies worldwide. ICT has been recognised as a crucial tool for facilitating the delivery of vital

services and creating opportunities for sustainable livelihoods (Fernández-Portillo et al., 2020; Rabelo and Gusmeroli, 2008). The increasing interconnection of individuals in modern society has been facilitated by the widespread availability of electronic information, e-commerce platforms, avenues for expressing opinions, electronic messaging systems, e-government services, and access to these resources through internet-enabled devices. This field is widely recognised as a crucial factor in the progress and advancement of a nation (Zafar and Aftab, 2007; Fernández-Portillo et al., 2020). In contemporary times, there is an apparent shift in basic economic organisations from the traditional neo-classical economics framework towards adopting Austrian economics principles. This transition is characterised by a fundamental shift of focus from conventional production and consumption patterns towards a greater emphasis on innovation, new technology, creative product development, and proactive pursuit of novel avenues for innovation (Nelson and Plosser, 1982; Teece, 2014). Rapid digital economy and ICT progress have resulted in a transforming era of economic innovation, significantly impacting societal well-being.

The existing literature on digital disparities has significantly emphasised macroeconomic factors, such as foreign direct investment, remittances, and GDP per capita (Billon et al., 2009). The research conducted by Chinn and Fairlie (2007) places significant emphasis on government effectiveness and regulation's role. In contrast, Pick and Nishida (2015) propose that factors such as illiteracy and years of schooling play a crucial role in explaining the variations observed in adopting information and communication technology (ICT). In contrast, a considerable body of literature has examined the digital divide from a micro-level perspective. The research has revealed that disparities in digital technology adoption may stem from factors such as educational attainment and socioeconomic status (Nishijimaa et al., 2017). According to Narayana (2011), individuals from vulnerable populations and marginalised ethnic groups exhibit a reduced likelihood of digital inclusion. The influence of employment status on digital technology adoption is significant, as noted by Narayana (2011). Additionally, demographic factors such as age, gender, area, region and household income have also been identified as important determinants of technology adoption (Thomas & Parayil, 2008; Gupta & Jain, 2015; Shair et al., 2022).

2. METHODOLOGY

The current investigation assesses the probability of an individual being classified into a specific category, considering demographic, regional, and socioeconomic traits. In a study based on microdata, the choice of an economic model for empirical estimation depends upon the nature of the dependent variable. Given that the dependent variable consists of multiple categories in our setting, it is appropriate to utilise Multinomial logistic regression. Multinomial logistic regression is a statistical technique that serves as an extension of logistic regression. It is specifically employed when the dependent variable exhibits nominal qualitative outcomes encompassing more than two distinct categories. Multinomial logistic regression estimates the likelihood of an individual being assigned to a specific category within the dependent variable (Greene, 2012; Shair et al., 2023; Halim et al., 2022). The regression model for the estimation of the outcome variable is as follows.

$$Digital\_divide_i = \beta_0 + \beta_1 Age_i + \beta_2 Male_i + \beta_3 Married_i + \beta_4 Education_i + \beta_5 Urban_i + \beta_6 Punjab_i + \beta_7 Sindh_i + \beta_8 Balochistan_i + \beta_9 HHincome_i + \beta_{10} Employed_i + \beta_{11} Wage_i + \sum_{j=1}^{9} \beta_{12j}\, Employment\_status_{ij} + \varepsilon_i \qquad (1)$$

In equation 1, the dependent variable consists of three distinct qualitative categories: individuals who do not possess a personal mobile phone, individuals who possess a personal mobile phone, and individuals who possess a personal mobile phone and utilise the internet. The determinants of the digital divide encompass various socio-economic, demographic and regional factors. It includes age, gender, marital status, education level, urban or rural area of residence, household income, wages, and employment status (nine distinct employment categories). Three distinct models were implemented in this study, each following the same equation (equation 1), with the only change being the alteration of the covariates. In the first model, age is treated as a continuous variable. In the second model, the analysis was conducted by treating age as a categorical variable. The third model uses a sample of employed individuals to assess the impact of various employment statuses on the digital divide. The variables utilised in the analysis are provided in Table 1.

3. DATA AND DESCRIPTIVE ANALYSIS

The present study employs an empirical analysis approach, drawing upon data from the Pakistan Social and Living Standards Measurements (PSLM) survey conducted during 2019-20. The data employed in this study was acquired from the official website of the Pakistan Bureau of Statistics (PBS). The PSLM survey conducted during 2019-20 represents the twelfth iteration of a comprehensive survey series initially launched in 2004. The most recent version of the PSLM district-level survey involved an extensive sample size consisting of 5,893 blocks and 176,790 households. The present study utilised a total sample size of 814,267 individuals to conduct regression analysis. The primary objective of the survey was to collect comprehensive data on a range of district-level indicators related to Education, Health, Housing, Water Sanitation and Hygiene, Information Communication and Technology (ICT), Food Insecurity Experience Scale (FIES), Functional

Limitation (Disability), and lifetime Migration. The primary aim of PSLM-HIES survey was to observe and track 21 indicators pertaining to the Sustainable Development Goals (SDGs).

The descriptive analysis of the variables use in the study are presented in Table 2. The descriptive analysis categorised into four distinct groups. The first group consists of the whole sample, while second group comprises individuals who do not possess a mobile phone. The third group includes individuals who possess a personal mobile phone. Lastly, the fourth group consists of individuals who possess a mobile phone and also use the internet. The observed sample found that 30 per cent of individuals did not possess a mobile phone, whereas 56 per cent possessed a personal mobile phone.

Table. 1 Definition of the variables used in the analysis

Variable	Description
Dependent variable	
Digital divide	It is a multinomial categorical variable comprises 1 if individual did not have mobile, 2 if individual has personal mobile phone but did not use internet, 3 if individual have personal mobile phone and also use internet.
Independent variable	
Age	It is a continuous variable in year in one setting. While in other setting it is also comprises eight ordinal categories. For instance, age1 for below 20; age2 for 20-29; age3 for 30-39; age4 for 40-49; age5 for 50-59; age6 for 60-69; age7 for 70-79; age8 for 80 or above.
Male	It is a dummy variable coded 1 for male, 0 otherwise.
Married	It is a dummy variable coded 1 for married, 0 otherwise.
Education	It is a discrete variable comprises the year of education. It ranges zero for no education to 21 for PHD.
Urban	It is a dummy variable coded 1 for urban area individual, 0 otherwise.
KPK	It is a dummy variable coded 1 for individual from KPK, 0 otherwise.
Punjab	It is a dummy variable coded 1 for individual from Punjab, 0 otherwise.
Sindh	It is a dummy variable coded 1 for individual from Sindh, 0 otherwise.
Balochistan	It is a dummy variable coded 1 for individual from Balochistan, 0 otherwise.
HH income	It is a continuous variable comprises the sum of monthly all labour and non-labour household income.
Employed	It is a dummy variable coded 1 for individual who is employed, 0 otherwise.
Wages	It is a continuous variable comprises monthly labour income of the individual from the employment.
Employer1	It is a dummy variable coded 1 if individual responded employer with 1-9 employees, 0 otherwise.
Employer2	It is a dummy variable coded 1 if individual responded employer with 10 or above employees, 0 otherwise.
Self-employed	It is a dummy variable coded 1 if individual responded self-employed, 0 otherwise.
Paid-employed	It is a dummy variable coded 1 if individual responded paid-employed, 0 otherwise.
Contributing family	It is a dummy variable coded 1 if individual responded unpaid family worker, 0 otherwise.
Own cultivator	It is a dummy variable coded 1 if individual responded own cultivator, 0 otherwise.
Share cropper	It is a dummy variable coded 1 if individual responded share cropper, 0 otherwise.
Contract cultivator	It is a dummy variable coded 1 if individual responded contract cultivator, 0 otherwise.
Livestock	It is a dummy variable coded 1 if individual responded livestock, 0 otherwise.

In contrast, it is found that, specifically, 13 out of 100 individuals reported ownership of a mobile phone and utilisation of internet services. The average age of individuals in the sample is 24 years old. However, in the subset of individuals who do not possess a personal mobile phone, the average age is approximately 11 years old. Furthermore, the age of individuals who possess a personal mobile phone and use the internet is lower than those who only possess a mobile phone. In the provided sample, it is observed that 51 per cent of the individuals are male.

Furthermore, it is noted that the proportion of males is comparatively lower in the subgroup of individuals who do not possess a mobile phone compared to the proportion of females in the same subgroup. The category of individuals who possess mobile phones and use the internet exhibits a higher proportion of males, specifically 65 per cent. The category of individuals with only a mobile phone exhibits a higher proportion of married individuals, in contrast to the other two categories, where a lower proportion of married individuals is observed.

The mean level of education in the whole sample is approximately 4 years, indicating a higher prevalence of individuals with no education at all. In contrast, it is noteworthy that individuals who possess a mobile phone and utilise the internet

exhibit a higher average educational attainment. The data suggests a decline in the average years of education during the transition from individuals who possess mobile phones to those who do not. In our sample, it has been observed that 30 per cent of individuals belong to the urban area. However, upon further analysis, it has been found that the proportion of individuals from the urban area is comparatively lower among those who still need a mobile phone.

Table 2. Descriptive statistics

Variable	Whole sample N=870,171	No mobile device sample N=266,814	Mobile device sample N=487,736	Mobile and internet sample N=115,612
	Mean	Mean	Mean	Mean
No mobile (=1)	0.307			
Mobile (=1)	0.561			
Mobile & internet (=1)	0.133			
Age	24.118	10.597	30.545	28.21
Male (=1)	0.514	0.49	0.494	0.655
Married (=1)	0.401	0.075	0.558	0.493
Education	3.981	1.798	3.643	9.414
Urban (=1)	0.293	0.246	0.263	0.529
KPK (=1)	0.213	0.242	0.209	0.16
Punjab (=1)	0.486	0.445	0.499	0.532
Sindh (=1)	0.203	0.216	0.189	0.236
Balochistan (=1)	0.098	0.097	0.104	0.072
HH income	38414.4	32344.34	35043.11	66647.68
Employed (=1)	0.269	0.047	0.347	0.448
Age (Below 20)	0.495	0.888	0.332	0.275
Age (20-29)	0.163	0.047	0.186	0.329
Age (30-39)	0.127	0.014	0.171	0.2
Age (40-49)	0.094	0.01	0.136	0.111
Age (50-59)	0.065	0.008	0.099	0.055
Age (60-69)	0.038	0.01	0.056	0.022
Age (70-79)	0.014	0.015	0.015	0.006
Age (80 or above)	0.005	0.007	0.004	0.001
Wages	22191.4	11799.87	18740.02	36045.42
Employer1	0.013	0.005	0.009	0.028
Employer2	0.005	0.003	0.003	0.011
Self-employed	0.198	0.1	0.194	0.235
Paid-employed	0.469	0.393	0.444	0.57
Contributing family	0.139	0.286	0.144	0.087
Own cultivator	0.088	0.068	0.102	0.048
Share cropper	0.037	0.077	0.043	0.007
Contract cultivator	0.015	0.01	0.019	0.005
Livestock	0.035	0.058	0.042	0.007

Conversely, among individuals who own a mobile phone and use the internet, the proportion of individuals from the urban area is higher. The presence of a regional disparity in the context of the digital divide becomes evident when considering the data that indicates individuals from the province of Punjab, which is relatively more advanced, exhibit a mobile ownership and internet usage rate of 53 out of 100. In contrast, it has been observed that a relatively low percentage of individuals, specifically 7 out of 100 residing in the underprivileged province of Balochistan, possess mobile phones and have access to the internet.

The significance of employment is a crucial aspect to consider when examining the digital divide phenomenon. In the present study, it is observed that a small proportion of individuals who participated in labour, specifically 5 out of 100, reported a lack of ownership of mobile phones. In contrast, it has been observed that a greater percentage of currently employed individuals exhibit ownership of mobile phones and engage in internet usage, as compared to individuals who are not yet employed. In the provided sample, it is observed that approximately 60 per cent of individuals aged below 30 reported owning a mobile phone and utilising internet services. In contrast, it is found that 40 per cent of individuals within the age group of 30 years and above indicated that they own a mobile phone and engage in internet usage. The data suggests

a greater prevalence of digital technology usage among younger individuals than older individuals. The data suggests that individuals with mobile phones and internet services exhibit higher wage levels. The observed wage disparity between individuals with access to mobile and internet technologies and those without is estimated to be three times greater. The wages of individuals decrease as they transition from having a mobile phone with internet usage to not having any mobile phone at all. The significance of employment status is undeniably crucial when elucidating the digital divide phenomenon. The individuals who possess mobile phones and utilise the Internet exhibit a greater prevalence of individuals engaged in paid employment and self-employment. Approximately 80 per cent of individuals can be classified within this particular category, among other

4. RESULTS AND DISCUSSION

The aftermaths of the Multinomial Logit model are presented in Table 3. To enhance the comprehension of the coefficients, we offer an analysis of the marginal effect associated with each outcome. We run two models following the effect of age on the outcomes of the digital divide. Model 1 uses the age variable as a continuous variable, while Model 2 treats the age variable as a categorical variable. The relationship between the coefficient of age as a continuous variable and the various outcomes of the digital divide presents a perplexing scenario. The findings about the digital divide reveal that advancing age is inversely associated with the probability of not owning a mobile phone. Conversely, it is positively associated with using mobile phones without internet access while exhibiting a negative relationship with adopting internet-enabled mobile phones. The examination of the impact of age on the digital divide can be further enhanced by adopting a categorical variable approach to model age.

The analysis of the gender coefficient indicates that there is no significant difference in the likelihood of not using mobile devices between males and females. In contrast, it is observed that males exhibit a lower probability of possessing a mobile phone devoid of internet connectivity as compared to females. According to our findings, males have a 3.2 per cent higher probability of possessing a mobile device that can access the internet. The gender gap has been identified as a potential contributing factor to the digital divide, as it appears that males tend to dominate in traditional societies while women are often less empowered in decision-making processes. In a developing country such as Pakistan, it is observed that women are disproportionately vulnerable. This vulnerability can be attributed to cultural values, societal norms, and limited economic engagement. It has been observed that women, similar to their male counterparts, also perceive and acknowledge the existence of an opportunity differential when accessing basic human needs.

The findings indicate that married individuals have a lower probability of not using a mobile phone and a higher probability of owning a mobile phone than those who are not married. According to our research findings, married individuals exhibit a higher probability, approximately 3.2 per cent, of owning a mobile device that is utilised for internet access. The presence of a digital divide can be noticed when comparing the access and usage of digital technologies between individuals who are married and those who are unmarried. The notable prevalence of internet-enabled mobile phones can be attributed to the inherent nature of married individuals to prioritise household responsibilities, necessitating technology integration into their daily lives. Furthermore, the abundance of information accessible on digital platforms is crucial in facilitating the decision-making process of married individuals and their households.

This study's findings indicate a negative relationship between the coefficient of education and the likelihood of not using a mobile phone. Moreover, it suggests that an increase in years of education is associated with a higher likelihood of owning a mobile phone and a mobile device with internet access. Specifically, for every additional year of education, there is an associated increase of 1.8 per cent in the probability of owning such a mobile phone with internet usage. The potential digital divide among individuals can be attributed to disparities in educational attainment. The visible higher prevalence of internet-enabled mobile phones can be attributed to the inherent complexities associated with internet usage, excluding the low-educated person (Reinartz, 2016).

Furthermore, it is worth noting that the widespread dissemination of digital skills globally is predominantly accessible to individuals with a higher level of education. This phenomenon consequently leads to an increased demand for cutting-edge technological advancements. The presence of a readily accessible stock of knowledge on digital platforms plays a crucial role, particularly for individuals with a higher level of education. This availability facilitates the transfer of intellectual capital, leading to increased financial benefits and the transition towards a knowledge-based economy. These factors, along with various others, play a significant role in facilitating greater accessibility to focal technology for individuals with higher levels of education.

The findings indicate that employed individuals have a 13 per cent lower probability of not using a mobile phone than those not in the labour force. Additionally, there is a 10 per cent higher likelihood of owning a mobile phone and a 3.2 per cent higher probability of owning a mobile device that enables internet access than their non-labour participating counterparts. The higher prevalence among employed individuals can be attributed to their frequent engagement in correspondence about work-related activities with their counterparts. This communication is deemed essential and indispensable in the context of their employment. Additionally, it is worth noting that access to focal technology is contingent upon one's purchasing power, which is typically higher for employed individuals than those not actively participating in the labour force.

According to the coefficient of area, individuals residing in urban areas exhibit a 0.8 per cent lower probability of not using mobile devices than those in rural areas. Additionally, urban residents have a 5 per cent less likelihood of owning a mobile phone and a 5.8 per cent more likelihood of owning a mobile phone with internet access than their rural counterparts. The potential digital divide stemming from urban-rural disparities is influenced by low purchasing power, which hinders access to essential technologies and limited infrastructure development. These factors contribute to the existence of the digital divide.

Table 3. Estimates of the Multinomial Logit model on digital divide

Variables	Model 1			Model 2		
	No mobile	Mobile	Mobile & internet	No mobile	Mobile	Mobile & internet
Age	-0.0042***	0.0053***	-0.0011***			
	(0.0000)	(0.0000)	(0.0000)			
Male(=1)	0.0014	-0.0341***	0.0327***	-0.0077***	-0.0342***	0.0419***
	(0.0009)	(0.0011)	(0.0007)	(0.0008)	(0.001)	(0.0008)
Married(=1)	-0.1999***	0.1671***	0.0328***	-0.0939***	0.0918***	0.0021**
	(0.0012)	(0.0014)	(0.0009)	(0.0015)	(0.0016)	(0.0009)
Education	-0.0224***	0.0042***	0.0182***	-0.022***	0.0051***	0.0168***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Employed	-0.1319***	0.0998***	0.0321***	-0.0999***	0.0881***	0.0118***
	(0.0011)	(0.0013)	(0.0009)	(0.0011)	(0.0013)	(0.0009)
Urban(=1)	-0.0085***	-0.0495***	0.058***	-0.0046***	-0.0529***	0.0574***
	(0.001)	(0.0012)	(0.0008)	(0.0009)	(0.0011)	(0.0008)
Punjab	-0.0263***	0.0148***	0.0115***	-0.025***	0.014***	0.0109***
	(0.0011)	(0.0012)	(0.0008)	(0.001)	(0.0012)	(0.0008)
Sindh	-0.0026**	-0.0233***	0.0259***	-0.001	-0.0248***	0.0258***
	(0.0013)	(0.0016)	(0.0012)	(0.0012)	(0.0016)	(0.0012)
Balochistan	-0.0374***	0.0287***	0.0087***	-0.0325***	0.0248***	0.0077***
	(0.0013)	(0.0018)	(0.0014)	(0.0012)	(0.0017)	(0.0013)
Ln(hhincome)	-0.0244***	-0.0205***	0.0448***	-0.0231***	-0.022***	0.0451***
	(0.0004)	(0.0005)	(0.0004)	(0.0004)	(0.0005)	(0.0004)
Age 80 or above (base)						
Age (Below 20)				0.0096**	-0.0868***	0.0771***
				(0.0043)	(0.0078)	(0.0078)
Age (20-29)				-0.1198***	-0.049***	0.1688***
				(0.0025)	(0.0137)	(0.0144)
Age (30-39)				-0.1644***	-0.0004***	0.1648***
				(0.0016)	(0.0145)	(0.0149)
Age (40-49)				-0.1566***	0.0446***	0.1121***
				(0.0014)	(0.0129)	(0.0131)
Age (50-59)				-0.1499***	0.0906***	0.0593***
				(0.0011)	(0.0105)	(0.0107)
Age (60-69)				-0.1246***	0.1023***	0.0222**
				(0.0014)	(0.0086)	(0.0087)
Age (70-79)				-0.0265***	0.0158***	0.0107
				(0.0042)	(0.0087)	(0.0086)
Frequency	212,469	486,248	115,550	212,469	486,248	115,550
Observation	814,267			814,267		
LR chi2	430816.92			448418.51		
Prob > chi2	0.0000			0.0000		
Pseudo R2	0.2828			0.2943		

According to the findings, the coefficient of the province variable indicates that individuals from the relatively advanced province of Punjab exhibit a 2.6 per cent lower probability of not using mobile phones than those from the less developed

province of KPK. Additionally, individuals from Punjab have a 1.5 per cent higher likelihood of owning a mobile phone and a 1.2 per cent higher probability of possessing a mobile device with internet connectivity than their counterparts from KPK. The higher prevalence observed in the comparatively advanced region can be attributed to several factors. Firstly, individuals in this region have greater opportunities to enhance their digital skills, which enables them to effectively engage with digital technologies. Additionally, the higher purchasing power of individuals in this region allows them to readily access the focal technology, facilitating their adoption and usage. Lastly, better digital infrastructure in this region ensures both the quality and widespread coverage of digital services, further contributing to the higher prevalence observed.

Table 4. Estimates of the employment status on digital divide

Variables	No mobile	Mobile	Mobile & internet
Age	-0.0001***	0.0042***	-0.0041***
	(0.0000)	(0.0001)	(0.0001)
Male(=1)	-0.0171***	-0.0139***	0.031***
	(0.0012)	(0.0024)	(0.0022)
Married(=1)	-0.0404***	0.061***	-0.0205***
	(0.0012)	(0.0021)	(0.0019)
Education	-0.0054***	-0.0193***	0.0247***
	(0.0001)	(0.0002)	(0.0002)
Urban(=1)	-0.014***	-0.0668***	0.0808***
	(0.0008)	(0.002)	(0.0019)
Punjab	-0.0041***	0.014***	-0.01***
	(0.0009)	(0.002)	(0.0019)
Sindh	0.0153*	-0.0013	-0.014***
	(0.0013)	(0.0024)	(0.0022)
Balochistan	0.0094***	0.0084***	-0.0178***
	(0.0014)	(0.0028)	(0.0025)
Ln(Wage)	-0.0081***	-0.0699***	0.0781***
	(0.0004)	(0.0012)	(0.0011)
Livestock (base)			
Employer1	-0.0089***	-0.1532***	0.1621***
	(0.0034)	(0.0148)	(0.0149)
Employer2	0.0157***	-0.1352***	0.1195***
	(0.0086)	(0.0179)	(0.0173)
Self-employed	-0.0123***	-0.0579***	0.0702***
	(0.0013)	(0.0082)	(0.0084)
Paid-employed	-0.006***	-0.052***	0.0581***
	(0.0014)	(0.0066)	(0.0067)
Contributing family	-0.006***	-0.0982***	0.1042***
	(0.0013)	(0.0096)	(0.0099)
Own cultivator	-0.0046***	-0.0239***	0.0285***
	(0.0016)	(0.0079)	(0.008)
Share cropper	0.0154***	-0.0042	-0.0112
	(0.0026)	(0.0083)	(0.0083)
Contract cultivator	-0.0107***	0.0159	-0.0052
	(0.0023)	(0.0097)	(0.0097)
Frequency	12,538	169,398	51,837
Observation	233,773		
LR chi2	85184.51		
Prob > chi2	0.0000		
Pseudo R2	0.2515		

The findings indicate a negative relationship between the coefficient of household income and the likelihood of not owning a mobile phone. Specifically, a unitary increase in the log of household income is associated with a 2 per cent decrease in the probability of not using a mobile phone and owning one. The findings of this study suggest for every 1 log point increase in household income, there is a corresponding 5 per cent increase in the probability of owning a mobile device with internet

capabilities. The increasing household income is a reliable indicator of the growing purchasing power, thereby alleviating budgetary constraints associated with acquiring and utilising essential digital technologies.

We disaggregated age as a continuous variable and subsequently converted it into eight distinct categories. This approach allowed us to estimate the differential impact of these age categories on the outcome of the digital divide (see model 2 in Table 2). The study results indicate that individuals who fall within the age brackets below 20 and 80 years or above exhibit a higher probability of not possessing a mobile device. In contrast, it has been observed that individuals belonging to the age groups below 20, 20-29, and 30-39 exhibit a higher probability, specifically 7 per cent, 17 per cent, and 16 per cent, respectively, of possessing a mobile device and utilising internet services compared to individuals within the age bracket of 80 years or above. Observing a greater prevalence of digital technology usage among younger individuals than older individuals suggests a potential association with self-efficacy. Self-efficacy is a psychological construct that pertains to an individual's perception of their ability to successfully engage in behaviours required to achieve specific performance outcomes (Bandura, 1977). Self-efficacy is also closely linked to the individual's belief in their capability to effectively influence and regulate their motivation, behaviour, and social surroundings (Bandura, 1986). The comparative analysis of self-efficacy levels reveals a notable disparity between younger and older individuals, with the younger exhibiting a relatively higher degree of self-efficacy than the older. Within the context of self-efficacy, it is worth noting that age is a significant factor contributing to the digital divide among individuals.

There exists a positive relationship between an individual's labour income and probability of possessing an internet-enabled mobile device. Based on the estimated coefficient, it can be inferred that a unitary log point increase in wage corresponds to an 8 per cent increase in the likelihood of owning an internet-enabled mobile device. The provision of focal technology has been found to be associated with higher labour income for individuals, as income helps to alleviate the financial constraint they may face. Furthermore, it is worth noting that an increase in income has been found to be positively associated with the adoption and usage of focal technology. This can be attributed to the fact that digital technology devices are classified as normal goods, meaning that as individuals' income rises, they tend to allocate a larger portion of their budget towards the acquisition and utilisation of such devices. This phenomenon can be explained by the notion that individuals perceive higher levels of utility or satisfaction from incorporating digital technology into their daily lives, thereby making it a desirable expenditure as their income grows.

The findings indicate a notable relationship between the coefficient of employment status and the likelihood of owning a mobile device and using the internet. Specifically, employers with less than 10 employees and more than 10 employees exhibit a 16 per cent and 12 per cent higher likelihood, respectively, of mobile ownership and internet usage. The trend of higher adoption of digital technology among entrepreneurs can likely be attributed to several factors, including the widespread utilisation of digital marketing strategies, the growing prominence of e-commerce platforms, the diffusion of innovative technologies, and the pursuit of enhanced product competitiveness. These factors are closely linked to utilising digital technology devices within entrepreneurial contexts. According to our findings, self-employed individuals exhibit a 7 per cent higher probability, and individuals who fall under the category of paid-employed have a 5.8 per cent greater likelihood of possessing an internet-enabled mobile phone. Likewise, family-contributing workers exhibit a 10 per cent higher probability of possessing an internet-enabled mobile phone. In contrast, individuals engaged in sharecropping, contract cropping, and livestock-related occupations are more vulnerable to limited digital technology access. It suggests that individuals from the farming occupation are digitally divided amongst others.

5. CONCLUSION

This study is an attempt to investigate the impact of various socioeconomic, regional, and demographic factors on the digital divide in Pakistan. The digital divide is conceptualised as the disparity in individual's access to mobile devices and internet connectivity. The empirical analysis in this study utilises microdata sourced from the PSLM survey, a nationally representative survey conducted during 2019-20. The study's findings reveal an apparent discrepancy in the outcomes associated with the digital divide. In this particular study, it was observed that approximately 1 out of 10 individuals possessed a mobile phone and utilised internet services. It was also found that 3 out of 10 individuals did not own a mobile phone. The findings from the regression analysis indicate that the lack of gender parity may serve as a factor contributing to the digital divide. Additionally, individuals with higher levels of education have greater access to internet-enabled mobile devices. Furthermore, being employed is positively associated with digital inclusion. Moreover, the digital divide is influenced by urban-rural gaps and regional disparity across the provinces. Research suggests a positive association between higher household income and individual wages with the likelihood of digital inclusion. On the contrary, it is imperative to acknowledge the significant influence of age in describing the digital divide among individuals. Younger individuals exhibit a higher propensity for digital inclusion than their older counterparts, primarily attributable to self-efficacy. The present study also observes the potential influence of employment status on the digital divide experienced by individuals.

The present study aimed to identify individuals who are marginalised within the digital realm and outline the necessary steps that must be undertaken to foster their inclusion. To address this objective, it is imperative to mitigate the gender gap, urban-rural divide, and regional disparities by implementing measures to reduce the disparity in opportunities and enhance

the quality of digital infrastructure. Furthermore, it is imperative to implement a comprehensive set of long-term policy measures to augment the average year of education and income levels of individuals and households, thereby facilitating a smooth transition towards the prospects of a knowledge-based economy. Facilitating the younger generation's transition into human capital is of utmost importance, as it contributes to the realisation of the youth dividend. This is particularly significant due to these individuals' notable presence of heightened self-efficacy.

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