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SOCIOECONOMIC FACTORS AFFECTING THE ADOPTION OF DIGITAL DEVICES AT HOUSEHOLD LEVEL IN PAKISTAN

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ABSTRACT

The effective use of digital devices has become an essential part of modern life. This study explores the socioeconomic determinants of the adoption of digital devices in Pakistan. The data has been obtained from the Pakistan Social Living Standard Measurement (PSLM) survey 2019–2020. A binary logistic regression model has been used. The dependent variable is the household adoption of digital devices i.e. computers, laptops, and tablets/iPads. Socioeconomic and demographic variables have been used as explanatory variables in the regression. The results conclude that the household adoption of digital devices is influenced by socioeconomic and demographic factors including gender, income, schooling years, and age. Receiving foreign remittances emerged as a positive predictor of the adoption of digital devices. Surprisingly, employed individuals are less likely to use digital devices. The study also highlighted a few behavioral factors that affect the adoption of digital devices. These factors i.e. lack of accessibility and affordability of devices, fears regarding security, and challenges associated with digital literacy, negatively affect the adoption of digital devices. Digital divide and digital inclusion have been studied for different economies due to their perceived benefits in modern lifestyles. As per our information, such household level analysis for Pakistan has not been performed. Pakistan has a lot of space for improvement in ICT infrastructure and accessibility. The study elucidates socioeconomic factors that can influence the implementation of digital technology, providing implications for policymakers, who seek to promote digital inclusion.

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INTRODUCTION

Information and communications technology (ICT) is significantly increasing global connectivity and revolutionizing the most features of modernized life (Asrani, 2022). The adoption and usage of hardware and software for communication and information are said to be digital technology, which plays a vital role in the growth and development of a country (Zafar and Aftab, 2007). The adoption of digital technology is critical in today's society due to its far-reaching ramifications across several industries (Karakara and Osabuohien, 2019; Mittal and Mehar, 2015; Piedrahita et al., 2017). Therefore, the digital divide has gained considerable attention from the research community (Warschauer, 2003; Van Deursen and Helsper, 2015; Puspitasari and Ishii, 2016). Computers, cell phones, the internet, and complex software applications are examples of digital technology tools and breakthroughs that have altered the way people live, work, and communicate (Acemoglu and Restrepo, 2020). Digital technology and the digital economy have significantly boosted communities and economies (Shair et al., 2023).

In addition, digital technology expands access to education and healthcare (Warschauer and Matuchniak, 2010). Individuals may obtain high-quality education (Warschauer, 2006) and medical consultations regardless of their physical location, thanks to the expansion of online courses and telemedicine services. Because the COVID-19 pandemic highlighted the necessity of digital technology to guarantee continuity in critical sectors, millions of students and patients sought out remote choices (Wijesooriya et al., 2020).

Although Pakistan is achieving major IT advancements recently, it now ranks 142 out of 166 countries in terms of internet availability; suggesting that accessibility and ICT infrastructure still have a lot of space for improvement (Junaidi, 2024). The information and telecommunications industry in Pakistan makes up a sizeable portion of the country's economy and is heavily dependent on computers and computer-related services. In addition to the poor infrastructure, a variety of other factors also influence the household's choice to use digital technology (Andrés et al. 2010 2016). Nearly 12 percent of households in Pakistan have reported having at least one facility such as a computer, laptop, and tablet (Pakistan Bureau of Statistics, 2019). According to the Pakistan Bureau of Statistics, 93 percent of households enjoy the facility of mobile or smartphones in Pakistan. Significant regional differences occur in the use of digital devices. Punjab is at the top with 13 percent of households having at least one facility such as a computer/laptop/tablet with 22 percent in urban and 8 percent in rural areas while Baluchistan is at the bottom with 6 percent of households using any of the facilities, out of which 13 percent in urban and only 1 percent in rural areas (Pakistan Bureau of Statistics, 2019).

In Pakistan, the gender disparity in mobile phone ownership has also expanded, with only half of women possessing a phone compared to more than three-quarters of men. Cybercrime has been on the rise, with over 100,000 complaints recorded by December 2022, the greatest amount in the previous five years.

According to data from the Interior Ministry, almost 0.3 million cybercrime complaints were filed between 2020 and 2022, yet just 124 persons were imprisoned. We can know more interconnected, right of entry into e-information, e-shop, voice opinion, e-massages, e-government services and gain consumer with the switch internet or touch by e-device (Government of Pakistan, 2022). Pakistan is a developing country with a huge population that presents many obstacles in terms of ICT infrastructure (Shair et al., 2022).

Education, income, and age are crucial aspects of digital technologies that have become vital to engaging digital inclusion. Digital inclusion, and digital literacy and its social outcomes are different due to demographic, social, and economic outcomes (Reder, 2015). Urban residential income, rural residential income, the worked-age population ratio, secondary education, and gross enrollment ratio are the most important determinants of the digital divide (Shair et al., 2022). The prominent studies suggested the three levels of the digital divide; the first one digital divide access to a digital device, which shows inequalities in access to ICT such as computers, laptops, workplace, or home. The second level of the digital divide is subject to the lack of an individual's ability to use ICT capabilities (Riggins and Dewan, 2005). The third level digital divide is related to output or outcome-based. The outcome is subject to enhancing the productivity of the individual by using ICT (Dewan and Riggins, 2005). Previous research looks at the digital gap in terms of access, basic usage, and applications among populations (Zafar and Aftab, 2007).

Digital inclusion includes not just access to the internet and broadband, but also access to software, hardware, and e-services for ICT use (Reder, 2015). Socioeconomic factors significantly affect family ICT reception, while education, age, and orientation classify individual ICT usage limits (Asrani, 2022).

Foreign remittances also play a vital role in the adoption of digital devices; foreign remittances are the electronic transmission of funds from one person or entity to another, generally across international borders. The transaction is performed using web platforms, smartphone applications, and other digital methods that allow users to send and receive money rapidly and securely (Yang, 2008).

The Pakistani government has taken steps to spread technology throughout the country. The glimpses of Pakistan's dynamic pattern of digital diffusion in Pakistan's Vision 2025 provide a visible path for the country's citizens as they work to become a developed nation. For Pakistan to achieve its economic goals of becoming a high-income country (top 10 world economies) by 2035 and an upper-middle-income country (top 25 global economies) by 2025, ICT adoption and usage are essential. It is necessary for this aim to evaluate the elements that might help close the digital gap. Therefore, the main objective of the study is to estimate socioeconomic factors affecting the adoption of digital devices at the household level in Pakistan.

Digital technology has transformed communication by linking individuals all over the world. Individuals may now connect in real-time and exchange information immediately because of the development of social media platforms, messaging applications, and video conferencing capabilities (Poushter, 2016). The digitization of transactions and data storage has also improved corporate operations by making information simpler to obtain and analyze, resulting in better decision-making (Wirtz et al., 2016). Digital technology has significantly enhanced education by making it more accessible, flexible, and personalized through online platforms, interactive e-books, and educational applications, thus enhancing student knowledge and holding (Grosseck et al., 2020).

Telemedicine has also grown in popularity, providing remote access to healthcare services, particularly in underprivileged regions (Topol et al., 2015). The digital divide (DD) has taken on new significance since the COVID-19 pandemic began (Aissaoui, 2022; Korovkin et al., 2022). The Coronavirus pandemic has shifted consumer and advertising behavior, emphasizing the benefits of mobile commerce and health security (Kao and Huilliend, 2022). The COVID-19 pandemic has also revolutionized the education sector through flourishing online learning platforms (Qazi et al., 2020).

There exists a significant gap in the use of digital technology among Pakistanis (Abdullah, 2015; Shair et al., 2022). The inconsistent global impact of the web has raised concerns about a digital divide between the wealthy and the less wealthy in South Asian countries (Jamil, 2021). The rapid adoption of ICT technologies like mobile phones, computers, the internet, radio, and television can significantly reduce production and marketing inefficiencies (Akmal, 2021). The scope of developed European economies benefits from advancements in ICT deployment and use (Portillo et al., 2020). Adoption of digital devices is important for children's education (Park et al., 2019). The most accessible information and communication technology available today is mobile phones (Vimalkumar et al., 2021).

METHODOLOGY

The 12th series from the surveys of Pakistan's Social and Living Measurements (2019-2020) has been used for the research study. A sample of 5,893 enumeration blocks and 176,790 households from all over Pakistan has been covered in this wave. PSLM survey encompasses a wide range of information related to Sustainable Development Goals SDGs. The survey covers information from Pakistani households on education, health, housing infrastructure, water and sanitation, hygiene, information communication and technology, food insecurity experience scale, functional limitations, and lifetime migration. The final dataset used for this study contains information from 873,659 individuals belonging to 160,340 households located in 126 districts of Pakistan for the year 2019-20. Out of which 70.68% belong to rural areas and 29.32% belong to urban areas with a maximum family size of 42. The data handling and analysis have been performed in Stata software developed by StataCorp. Individual level information has been aggregated to the household level for the analysis as per demand of the analysis. The labels and details of the aggregation of variables used in this study are given in Table 1.

Table 1. Description of variables, their labels, and aggregation.

Variables	Labels and aggregation from individual responses to household level
Dependent Variables: Adoption of digital devices	
Computer	Households that have at least one computer facility are marked as 1, otherwise =0
Laptop	Households who have at least one laptop facility are marked as 1, otherwise=0
Tablet	Households who have at least one Tablet/iPad facility are marked as 1, otherwise =0
Mobile	Households who have at least one mobile facility=1, otherwise=0
Independents Variables	

Gender	A cumulative measure of gender per household computed as no. of individuals who are male/total family size
Education	A cumulative measure of education per household computed from the average years of schooling of all individuals categorized into three levels i.e. low, medium, and high
Device Illiteracy	A cumulative measure of device illiteracy per household computed as no. of individuals who are illiterate about devices / total family size. So this variable records the complete ignorance of individuals about digital devices.
Device Affordability	A cumulative measure of device affordability per household is computed as no. of individuals who do not use devices due to high cost / total family size.
Perception about Privacy concerns	A cumulative measure of privacy concerns while using digital devices per household computed from no. of individuals who do not use devices due to privacy concerns / total family size
Perception about Usefulness of the device	A cumulative measure of the perception regarding usefulness of the devices per household. It has been computed from no. of individuals who do not use devices because the devices are not useful as per their perception/total family size. So, in fact this variable captures the perception of individuals about the not usefulness /needlessness of the devices for them. We kept the variable in the model without inverting it to usefulness as the survey asks individuals who do not use devices because the devices are not useful for them.
Employment status	A cumulative measure of employment status per household computed from no. of individuals who are jobian / total family size.
Foreign remittances	It is a dummy variable representing 1 for households who receive foreign remittances and 0 for others.
Age groups	A cumulative measure of age for a household is represented by two variables i.e. Middle age variable represents no. of individuals aged (17-49) / total family size, and the Old age variable represents no. of individuals aged (more than 49) / total family size.
Income	Sum of all type of income per household computed from three quantlies of per capita income of all individuals categorized into three levels i.e. low, medium, and high.
Region	It is a dummy variable showing 1 for households belonging to urban areas and 0 for rural area.
Provinces	It represents the fixed effects of all four provinces in Pakistan.
District	It represents the fixed effect of districts.

The perceptions related to behavioral aspects have been recorded in the survey at the individual level, however, as per the scope of our analysis, we aggregated the responses at the household level as mentioned above.

Logistic Model

As per the nature and purposes of this research study, the logit model has been used. The logit model is used for the prediction of the dependent variable where the dependent variable represents the adoption of digital devices (computers, laptops, tablets/iPads, and mobile phones) at the household level. The adoption has been recorded in binary form i.e. two possible values 1 and 0 as mentioned above in Table 1. Thus, four logistic regressions were estimated. The logistic model in our study is as follows.

$$\text{Logit score Adoption of Digital devices} = \alpha + \beta X_i + \mu_i \quad (1)$$

Where α is intercept and β is a vector of logit model coefficients for Xi's i.e. all independent variables given in Table 1, and μ_i represents the idiosyncratic term. Descriptive statistics of the variables used in this study are presented in Table 2.

Table 2. Summary of variables.

Variable	Mean	Std. Dev.	Min	Max
Computer	0.059	0.236	0	1
Laptop	0.061	0.239	0	1
Tablet	0.012	0.259	0	1
Mobile	0.927	0.259	0	1
Gender	51.585	17.47	0	100
Education category	2.316	0.714	1	3
Device illiteracy	0.572	0.388	0	1
Device affordability	0.062	0.19	0	1
Perception about privacy concerns	0.002	0.03	0	1
Perception about the usefulness of the device	0.153	0.293	0	1
Employment status	14.293	17.97	0	100
Foreign remittances	0.06	0.238	0	1
Region	0.311	0.462	0	1
Middle age	0.492	0.228	0	1
Old age	0.121	0.204	0	1
Region	0.311	0.462	0	1
Income in categories	1.991	0.821	1	3
Province	2.242	0.854	1	4
District	241.429	85.2	101	433

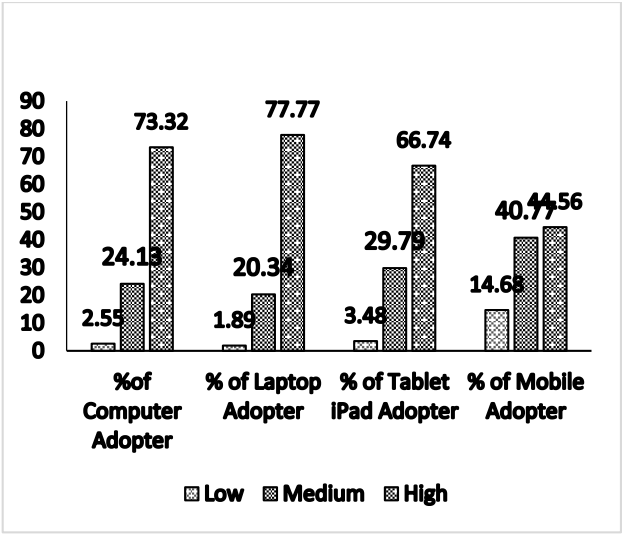
Note: Total observations are 160,340.

RESULTS AND DISCUSSION

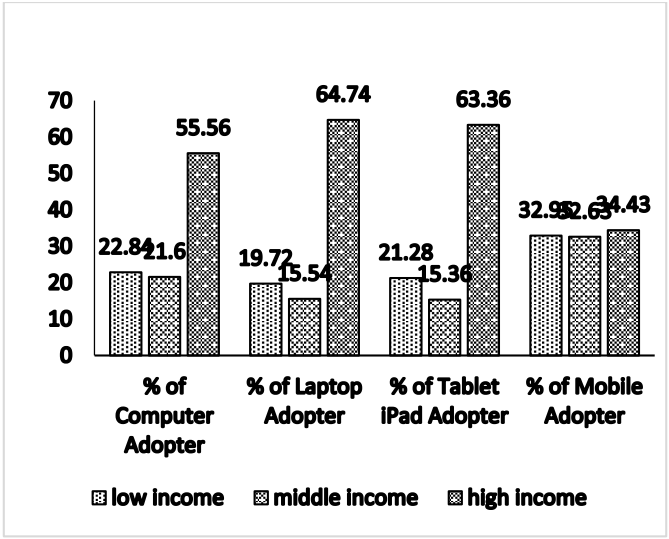
Figure 1 panel: A shows higher usage of digital devices (computers, laptops, tablets/iPads, and mobile phones) for more educated people as high adoption rates are recorded for the high education category. However, this digital divide among various educational groups is lower in the adoption of mobile phones which depicts mobile phone adoption as deemed necessary as compared to other digital devices (computers, laptops, tablets/iPads).

Figure 1 Panel: B shows that families with high incomes are more likely to adopt computers, laptops, tablets/iPads, and mobile phones as compared to low- and middle-income households. Computer adoption rates are higher than laptop adoption for low- and middle-income categories however, in the high-income group laptops are preferred over computers. The adoption rates for mobile phones are constant across income groups.

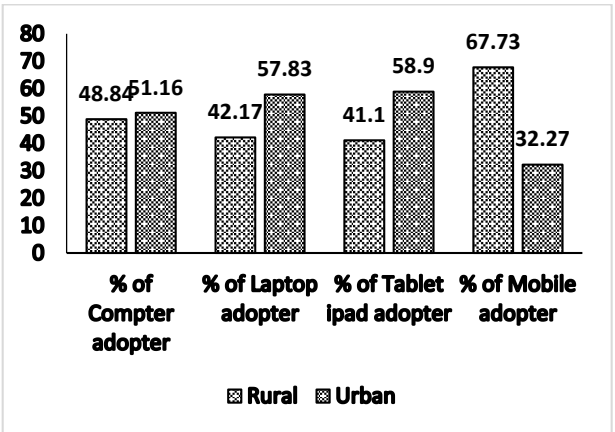
Figure 1 Panel: C shows that when compared to rural regions, urban areas have slightly greater rates of computer, laptop, and tablet/iPad adoption, while rural areas have much higher rates of mobile phone use. Figure 1 Panel: D shows that Punjab has the greatest rate of technology adoption, followed by Sindh, which prefers tablets, and Baluchistan, which has the lowest adoption rates, showing a need for additional technical improvement. These regional differences occur due to underpinning differences in infrastructure, access to the internet, educational attainments, culture, and economic activities.



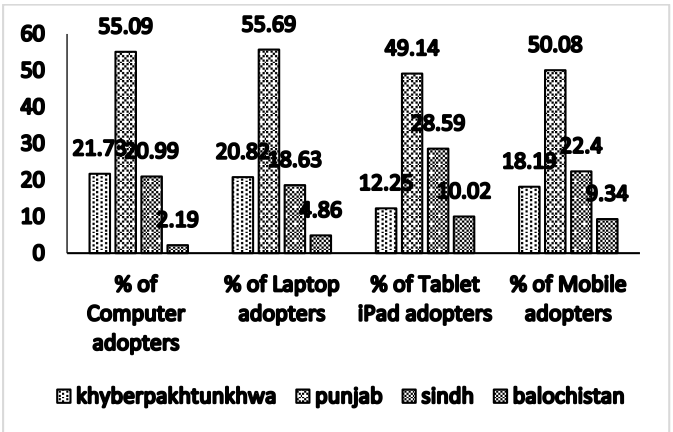
Panel-A: Percentage of adoption of digital devices by schooling years



Panel-B: Percentage of adoption of digital devices by different income groups



Panel-C: Percentage of adoption of digital devices by regions



Panel-D: Percentage of adoption of digital devices by provinces

In Table 3 the coefficient of gender points out the gender-based digital divide in Pakistan where males are more likely to use digital devices compared to females. The positive coefficient for the gender variable in all models shows higher chances of adoption (of digital devices) for households as the number of male inhabitants increases in a household. Mumtaz (2000) found that men's occupational influence and gendered socialization have an impact on their home computer adoption. Men's perceived usefulness and comfort in using laptop computers for business, pleasure, or communication, as well as economic considerations such as greater income levels, may affect adoption rates (Venkatesh and Morris, 2000). Furthermore, cultural conventions and gender roles may contribute to gendered laptop adoption trends (Hargittai, 2010). According to Chib and Sandhu (2016) the impact of gender roles on tablet/iPad adoption within households, their

change over time, socioeconomic determinants, cultural and social norms, and policy implications to eliminate gender-based inequalities in internet adoption and assess the impact of interventions. According to Livingstone and Helsper (2007), several significant factors explain the likelihood of adopting Tablets / iPads. In Pakistan's overall adoption model, higher educational attainment and higher income levels are linked to greater technology adoption, with men generally being more likely to purchase and adopt tablets as per Hargittai (2010). Moreover, Tablets / iPads are more likely to be used by men for work-related activities, potentially due to their perceived value for professional purposes.

Table 3. Regression analysis Adoption of digital devices at the household level.

Models	Computer	Laptop	Tablet	Mobile
Variables				
Gender (male/all)	0.136**	0.190***	0.221*	0.880***
	2.14	2.8	1.66	14.99
Education (categories based on an average year of schooling in the household)				
Low	Base category (.)	Base category (.)	Base category (.)	Base category (.)
Medium	0.891***	0.816***	0.669***	0.597***
	(12.91)	(10.31)	(5.08)	(16.84)
High	1.832***	1.927***	1.004***	-0.615***
	(27.28)	(25.03)	(7.75)	(-21.05)
Device illiteracy(individual / all)	-2.700***	-3.507***	-2.758***	-1.516***
	(-64.06)	(-76.11)	(-30.69)	(-27.57)
Device affordability (individual / all)	-2.656***	-4.231***	-4.481***	-1.507***
	(-29.81)	(-34.10)	(-14.82)	(-19.53)
Perception about Privacy concerns (individual / all)	-1.751***	-1.862***	-1.012*	-0.743
	(-5.19)	(-5.93)	(-1.72)	(-1.55)
Perception about Usefulness of the device (individual / all)	-1.891***	-2.739***	-2.476***	-1.146***
	(-39.52)	(-52.61)	(-22.98)	(-17.74)
Employment status: (individual / all)	-0.447***	-0.700***	-0.549***	0.138**
	(-6.84)	(-10.28)	(-3.91)	(2.23)
Dummy (foreign remittances receiving =1)	-0.033	0.146***	0.484***	0.316***
	(-0.76)	(3.41)	(5.97)	(5.14)
Age groups				
Middle-aged / all	0.670***	1.365***	-0.467***	0.259***
	(11.55)	(22.12)	(-3.76)	(4.89)
Old-aged / all	0.706***	1.505***	-0.326***	-1.341***
	(12.02)	(24.41)	(-2.59)	(-28.45)
Region (urban=1)	0.53***	0.589***	0.318***	0.565***
	(18.83)	(19.28)	(4.97)	(17.96)
Household income				
Low income	Base category (.)	Base category (.)	Base category (.)	Base category (.)
Middle income	0.0258	-0.151***	-0.383***	0.292***
	(0.78)	(-3.97)	(-4.83)	(12.24)
High income	0.373***	0.493***	0.342***	0.730***
	(12.47)	(15.65)	(5.41)	(24.89)
Provinces				
KPK	Base category (.)	Base category (.)	Base category (.)	Base category (.)
Punjab	-1.023***	0.266	-1.660***	-1.018***
	(-5.82)	(1.27)	(-2.90)	(-4.81)
Sindh	-1.446***	-1.816***	-0.934	-0.782***
	(-5.53)	(-4.24)	(-1.62)	(-3.45)
Baluchistan	-2.373***	-1.767*	-1.698	0.925**
	(-3.29)	(-1.73)	(-1.63)	(2.16)
Constant	-2.651***	-3.820***	-3.418***	4.002***
	(-18.38)	(-19.95)	(10.64)	(20.05)
N	157528	156997	144862	160340
Joint significance	0.000***	0.000***	0.000***	0.000***

Notes: The reference category for the region variable is households belonging to rural areas. The t statistics are reported in parentheses while asterisks show significance level i.e. * p<.10, ** p<.05, *** p<.01.

In Table 3 education plays a positive role in the adoption of digital devices. Higher schooling years have higher usage of devices with a different magnitude associated with types of devices. This shows that greater education levels are associated with higher rates of computer adoption because better education levels are associated with better levels of digital literacy and technical abilities, which can lead to higher adoption rates (Katz et al., 2001). Households with a moderate or high degree of education are more likely to be familiar with computers and to have access to computer-based educational resources. They may also be in jobs that demand computer abilities, which can have an impact on adoption rates. Higher levels of education are often correlated with higher levels of money, which can lead to increased adoption rates. Households with greater education levels have a higher perceived value of

technology, particularly computers. Higher education levels are also related to more information and communication requirements, which can increase adoption (Puspitasari and Ishii, 2016). With peers and social networks, social influence and networks may also play a significant part in technological adoption (Van Deursen and Van Dijk, 2014). According to Niehm et al. (2010), higher education levels are often linked to greater technology adoption. Households with middle and high education levels possess the skills and awareness needed to use laptops effectively. However, the adoption of mobile phones is lower for households with high education levels as compared to the reference category of low education levels. Since the type of mobile phone used by respondents is not given in the survey, we have limited knowledge in explaining this lower adoption. One possible explanation is that digital devices partially substitute each other so Android mobile phones partly substitute computers, Tablets / iPad and vice versa.

Knowledge and perceptions related to digital devices also impact the adoption of digital devices in Pakistan. Device illiteracy, concerns about affordability, and concerns about device security have negative coefficients, which reveals lower chances of digital device adoption for people who have such concerns. The adoption of digital devices is also lower for individuals who perceive these devices are not useful to them. According to Gillett and Lehr (1999) households with more educated members, tend to be more comfortable using technology especially computers, which may result in a greater percentage of people owning computers. They are more aware of the benefits and costs associated with technology, which may affect their choice to purchase computers (Hargittai et al., 2010). Higher education levels are frequently linked to higher levels of device literacy since adoption rates of computers are increased by those who have better access to knowledge about its advantages. People who are capable with devices may also be motivated to acquire PCs at home by responsibilities related to their jobs or careers. With increased rates of technology usage in areas or communities with successful programs, device literacy may be a sign of exposure to digital inclusion initiatives. Since these households understand the advantages of having and using computers, the perceived value of technology, particularly computers, can influence computer ownership. Social networks and peer influence can play a significant role in technology adoption (Hargittai et al., 2010).

The digital divide also occurs because of the differences in the perceived costs and benefits related to digital device usage. Some households are reluctant to purchase computers because of the perceived costs (Rogers, 2003) cited in Sahin (2006)) and the perceived value of technology (Rogers et al., 2014). Due to security breaches, the perceived costs associated with cyber risks may have an impact on finances. In Table 3 the coefficient of Perception about privacy concerns shows a negative sign in all devices which depicts the lower chances of adoption among people with such concerns. Therefore, giving users access to sufficient security measures could encourage adoption. Regulatory compliance may have an impact on concerns about device security because families may be reluctant to adopt computers if they believe it will be difficult to comply with security-related regulations (D'Arcy et al., 2009). Malhotra et al. (2004) state that households concerned about the security of their devices may view computers as potential sources of threats and vulnerabilities, including malware, viruses, and data breaches. People's use of computers may be discouraged by this perception. Since households may be concerned about potential privacy violations linked to computer use, privacy problems and security concerns frequently intersect (Pavlou, 2003).

A lack of confidence in technology is another factor influencing its adoption. Understanding cyber security can make people more wary and affect their willingness to accept computers. The perceived losses brought on by cyber risks may have a financial impact on security breaches. Offering sufficient security measures to users could positively influence their adoption. Concerns about device security may also be impacted by regulatory compliance because households may avoid using computers if they believe it will be difficult to follow security-related laws (Siponen et al., 2012). As stated by Vance et al. (2012) families concerned about data breaches, malware, and viruses on devices may view computers as potential sources of dangers and vulnerabilities. This belief may discourage people from using computers. Worries about privacy sometimes overlap with worries about security, since families may be concerned about potential privacy violations linked with computer use. Another element that influences technology adoption is a lack of faith in technology. Cybersecurity awareness can influence the willingness of households to use computers by making them more cautious divide (Davis, 1989).

In Table 3 the coefficient of employment status shows a negative impact, which shows that the unemployed household has more likelihood for the usage of these devices than the employed household do. Households with a higher proportion of working family members may encounter time limits, restricted availability for technology use, conflicting demands on resources, and limited access to office technology. These can standoff computer adoption since they frequently need time for setup, maintenance, and use. Furthermore, homes with more working family members may face conflicting demands for financial resources, which may lead to a negative connection with computer adoption. Access to workplace technology may also lessen the perceived requirement for personal computer adoption. Employment income levels may also play a part in the digital gap. Technological abilities and computer expertise may also lead to a lesser chance of adoption. Differences in technology uptake among generations may also have an effect. Priorities for work-life balance may also exist (Ihm and Hsieh, 2015). Moreover, the survey data used in this study shows majority of the employees have low-paid jobs like blue collar and education less than a higher secondary school certificate. Therefore, these laborers have less likelihood of adoption. This also shows the job market dynamics in Pakistan. A potential productivity change can occur in low-paid jobs with digital skills and the adoption of digital technologies.

In Table 3 there is a positive association between the usage of laptops and tablets and the factor of foreign remittances. Foreign remittances can influence household technology adoption. These remittances may be used to meet basic requirements such as housing, education, and healthcare, limiting expenditure on non-essential products such as computers. Households receiving remittances may have different technological tastes and may choose not to invest in technology. Income diversification may influence technology adoption, although it is not always devoted to technology. Household cultural and social issues may affect technology adoption decisions. Adoption may be hampered by a lack of technological infrastructure in remittance-receiving countries. Educational attainment may also have an impact on technology adoption. Remittance usage patterns might vary, as can consumer behavior and attitudes toward technology among remittance recipients. Overall, understanding these criteria can assist in influencing remittance allocation and their impact on technology adoption (DiMaggio et al., 2001).

Table 3 also shows the digital divide with respect to different age groups however, the results show mixed effects. Households with

higher old aged individuals are less likely to adopt tablet/iPad and mobile phones whereas the adoption of computers and laptop is higher for household with more middle aged members. Older and middle-aged people may be more confident with computers since they have developed digital literacy abilities over time. The relevance of technology may also play a role; older people tend to think less highly of digital devices (Hargittai, 2010).

Table 3 depicts digital divide across different regions of Pakistan as well. The positive coefficient for urban area dummy shows that households in urban area are likely to adopt digital devices as compared to household in rural areas. According to Florida (2002), urban regions have stronger technological infrastructure, including greater internet connectivity and access to digital services, which encourages people to use computers. This is due to increased access to educational institutions and job opportunities requiring computer skills, which may necessitate the use of computers for education and work. Residents of cities may have a better socioeconomic position, which is frequently connected with more access to resources, such as computers. In urban settings, cultural and social norms may encourage normal computer usage, with social networks helping to shape positive views toward technology. The Internet provides greater access to information and services in urban areas, which can encourage adoption. Residents' propensity to accept new technology can be influenced by technological innovation clusters in urban areas.

In Table 3 the variable of income is also significant, and the findings show that the usage of devices increased with higher income. Higher-income households have more financial resources, making it simpler to finance the initial expenditures of obtaining computers and maintaining internet access. They are more likely to own various technology devices, including computers, which increases their chances of computer adoption. Higher-income households also have easier access to educational possibilities that need the use of a computer, such as online courses, instructional software, and research tools. Computer use is also required for professional and work purposes since many higher-paying positions demand computer skills and connectivity. Furthermore, higher-income persons frequently have greater educational resources and chances for gaining digital literacy skills, which increases the likelihood of computer adoption. In addition, better-income people are early consumers of consumer electronics, which contributes to greater computer adoption rates (Goolsbee and Klenow, 2006).

A variation in digital device adoption has been seen with different regions (provinces), as differences in provincial policies or regulatory frameworks influence the development of digital technology infrastructure, and physical constraints, such as distant places or challenging terrain, might make it difficult to construct a functional device infrastructure. Digital inclusion related initiatives can lead to higher device adoption rates (DiMaggio and Garip, 2012). In case of Laptops Punjab's adoption is higher because of the provincial laptop distribution policy. Balochistan has more rural and remote areas which makes it last in the list of digital device adoption. Including digital technology infrastructure, physical constraints, and policies related initiatives can elaborate regional differences better. However, we used PSLM survey data and we could not include such variables therefore, we mention them in our study limitations. We have only used the fixed effect of districts and dummy variables for urban areas to sum up regional differences in digital device adoption.

CONCLUSIONS AND RECOMMENDATIONS

The study uses a logistic model to analyze data from the Pakistan Social and Living Standard Measurement Questionnaire (2019-2020) and highlights the socioeconomic determinants that can spur the adoption of digital technology in Pakistani households. This study examines the impact of various demographics and digital technology base variables including age, income, schooling years, gender, device illiteracy, affordability, privacy concerns, and employment status on adoption of digital technology. Though, we included socio-demographic and perception related behavioral aspects in our model to explain digital device adoption. Results of the regression models show that the adoption of digital technology is more likely among males, and higher-income households. Households with older individuals are more likely to adopt digital devices however this higher adoption is not uniform across all devices as the adoption for tablets and mobiles is lower. Adoption is more likely among households receiving foreign remittances, and urban people; however, less adoption occurs among households those illiterate about digital devices, and households that have security and affordability issues for digital devices. Households inhabited by a higher number of employed individuals (employment status) are more likely to adopt mobile phones while the adoption of other devices is lower. Moreover, there exist significant differences in the adoption of digital devices in different regions of Pakistan.

This study has some limitations. Some of these limitations are being mentioned. We could not include infrastructure, access to the internet, prices of the digital devices, budget share of digital device usage, and cultural barriers related to different regions in Pakistan because the survey data does not provide information on this. With the help of regional fixed effects and rural/urban dummy, we only tried to isolate the combined effects of these regional differences.

The study highlights the importance of digital technology in Pakistan's households for modern lifestyle improvement. It suggests that digital technology adoption is linked to household income, increasing affordability, and availability of digital devices. Digital device use is strongly correlated with household income; with higher income, increasing device affordability (Asrani, 2022). Different digital skill development programs are being implemented across the region e.g. India (Pradhan Mantri Gramin Digital Saksharta Abhiyan), Bangladesh (Digital Skills Development Program), and also in Pakistan (Digiskills, Pakistan Digital Skills Program, Microsoft Pakistan's Digital Skills Initiative). However, there is still a lot of room for improvement and reaching to real masses. At the macro level, digital skill development leads to better job market outcomes, efficiency, social inclusion, freelancing, increasing employability, and boosting economic growth. These digital skill development initiatives are not possible without digital device adoptions. Federal and provincial governments can address the affordability issues, especially for learners of digital skills in vocational training institutes and university Business Incubation Centers (BICs). Other than digital device adoption a suitable ecosystem is essential to fully reap the benefits of digital device adoption and the use of digital devices to increase employability, freelancing, efficiency, and economic growth. The inclusion of skill-focused course modules in our educational and technical curriculum, expanding reliable internet access, creating awareness about digital device-related employment opportunities, and promoting skill-focused short course modules could be some initiatives.

The adoption and use of digital devices are greatly impacted by education, which highlights the necessity for government

initiatives to increase public awareness of digital technology. The government should focus on infrastructure in areas with limited device access to improve service quality. Rural areas may be targeted to achieve digital inclusion and skill development at rural areas. Foreign remittances and migrant contributions also contribute to digital technology adoption. Governments should enhance foreign remittances and encourage migrants to use digital technology legally. Governments should implement effective training programs for digital technology usage with an aim to enhance labor productivity. Digital software companies should address device security issues.

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