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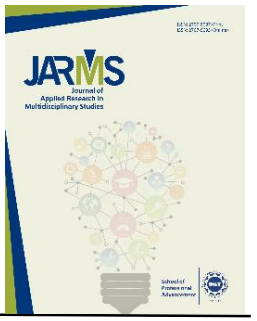

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Digitalization and Labor Market: A Case Study of Middle-Income Countries

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Abstract

The current study attempts to find the answers to critical concepts concerning the effect of digitalization on labor market in middle-income nations. It combines internet use and broadband subscriptions as explanatory variables to better understand digitalization. The study included five control variables to eliminate biases caused by the omitted variables. Rate of fertility, urban population proportion, female literateness, public expenditure as a GDP%, and GDP growth are used as control variables. To estimate the links between labor market and digitalization, the current study used ordinary least square (OLS) regression approach. The use of the internet and broadband subscriptions as indices of digitalization are used in this study. The study chooses 5 groups of economies were selected from the mid-income countries. The dataset is longitudinal, consisting of 89 countries for a 23-year period from 1995-2018. Hausman test is used to determine whether to adopt random effects or fixed effects model. The results showed that for groups 1, 3, 4, and 5, fixed effect proved to be a better model for both internet usage and broadband. The exception is group 2, where random effect model is a better fit for both the variables. The primary variable of interest, namely the log of internet usage, is found to be significant and positively correlated with the female labor force participation rates for groups 1, 4, and 5. However, it has showed a negative value for groups 2 and 3.One key novel finding of this study is that this holds for all the group of countries, thereby indicating that broadband provision helps to increase female labor force participation rates irrespective of the structure of society or income levels.

***Keywords*:** group, internet usage, labor force, labor market, population and growth

JEL Codes: E2, L86, J21, C92, P23 & N1

Introduction

Over the past 4 decades, the internet and certain related technologies have ushered in the information age, with technical change becoming the primary

source of global economic growth. Digitalization (use of digital platforms) has introduced capital biased technical change, resulting in the growth of internet users. This required development of physical infrastructure includes laying of long-distance optical fibers and last mile delivery systems including routers. The digitalization has also brought around phenomenal increases in broadband subscriptions, increased use of CPUs, along with cheaper and faster storage capacity. The digital age has itself evolved over this time period with transformation of hi-tech gadgets and advent of digital service delivery. However, the speed of evolution of the digital age, as well as the capital requirement for related digital infrastructure development, has also created global inequalities in all sectors of the economy, especially the labor sector. Digitalization of the economy requires a different set of skills, resulting in an unequal evolution of the labor force due to availability of resources and training.

The current research aimed to evaluate the influence of digitalization on labor market results by working on a cross-country time series of 5 groups in middle-income countries having same economic structures. Moreover, this study also examined how digitalization may have altered participation of labor force in 5 groups of middle-income economies from 1995-2018, obtaining data on macro level from the World Development Indicators. It also aimed to solve issues regarding the impacts of digitalization on labor market outcomes. To investigate the influence of digitalization on women involved in the labor force in middle-income nations.

The current study used ordinary least square (OLS) regression approaches to estimate the links between labor market results and digitalization. The essential interconnections between digitalization and labor market results are explored in this research. It also aimed to illustrate the main variables that may be used for employing digital technologies to empower women in workforce. Understanding the effect of digitalization in terms of gender, can potentially help decision-makers adopt more gender-sensitive policy decisions, benefitting women and allowing them to participate fairly in the labor market. Women frequently fall behind men in accessibility to ICTs as well as their abilities and literateness. Policies sensitive to gender can boost access for women not just for ICTs, however, also for economic potential, allowing them in contributing to the country's economic progress. On a global scale, world leaders are increasingly pledged to step up efforts in order to improve citizens' accessibility of

digitalization. They are also mortgaged to develop methods in order to merge their economies to adapt to digitalization. For the 2030 development agenda, this is true. Moreover, this study also raised a crucial point that technology would not resolve the issue of gender equality for policymakers. Irrespective of either, technology has a benefit or a negative impact on gender equality results. Authorities should make sure that women are well-versed in the required skills that are essential for ICTs. This would make them comprehend their potential and contribute to the labor market.

The current research is divided into eight segments. The opening section serves an introduction. Section 2 is based on a review of literature on female labor force participation (LFP) patterns in middle-income states, the relation among female LFP, and digitalization. Section 3 discusses theoretical framework. Research methodology is discussed in part 4 and the discussion of results are presented in section 5. The conclusion and takeout are listed in Section 6. Section 7 covers the weaknesses of the research and future research possibilities.

Literature Review

The current study aimed to comprehend the dynamics of digitalization's effect on female labor force participation rates. Many factors including development, trading and investment, social and public provision of services, and urbanization might influence the two variables according to this analysis. The study also compiled literature to create a literature framework to make a general summary of female labor force participation trends in countries with middle-income

Digitalization and its Role

Digital communication and digital media are referred to as "digitalization." To put it another way, digitalization is to use technology to build a new stream. Digitalization refers to the application of technology to a new economic or business paradigm (Chapco-Wade, 2018). In the meantime, digitalization is the internal procedure of creating a digital depiction of features and resulting in cost savings (Chapco-Wade, 2018; Rhyner et al, 2020).

Since individuals use extra computers, have more mobile devices, and engage in high-speed browsing, digitalization seems to be on rise. Furthermore, use of social media, is an example of online activities along with online commerce, digital, and online banking and internet of things

(IOT) are all expanding online presence. Digitalization is redefining, restructuring, and transforming the economy and labor markets (Muro et al. 2017). In 2019, over 8 billion cellular subscriptions, up from over 4.6 billion in 2009 and only 476 million in 1999 have been recorded (Muro et al. 2017). Additionally, there has been an increase in the number of computers purchased. The term "digitalization" is used in this study to refer to everyday ICTs, such as the internet, subscriptions for broadband, cellular phones, and wireless internet.

U-Shape Hypothesis and Female LFP Rate

The current study aimed to find an answer to the question, "Could digitalization reduce female labor force participation?" The focus, however, rests on mid-income nations, affected by countries classified as emerging or recently industrialized economies. These countries' economies have transitioned away from agriculture and rely more on manufacturing and service industries. Female labor force participation falls when nations go moving from a low to a middle-income situation, while it rises as they move from middle to higher-income status, in a U-shape slope (Goldin, 1994; Psacharopoulos & Tzannatos, 1989; Boserup, 2007; Sinha, 1967).

Due to reduced income level and significant percentage of agrarian production, Goldin (1994) revealed that poverty caused the female LFP rate to expand in lower-income nations. Attributed to an increase in the number of working females on family farms, social productivity is geared towards agricultural livelihood during the lower income phase, allowing higher women's participation (Psacharopoulos & Tzannatos, 1989; Goldin, 1994) owing to higher levels of education, increased social safety, and higher pay. As a country moves from a lower to middle income status, it enters the initial stages of industrialization, when female labor force participation falls.

Women are excluded throughout the early stages of industrialization due to physical restrictions, gender discernment, and the needs for livelihood (Pampel & Tanaka, 1986). In the early mid-income phase, countries undergo reorganization, with mechanical agriculture and in terms of manufacturing, industrial expansion is underway, both of which necessitate technologies (Goldin, 1994; Pampel & Tanaka, 1986). Resultantly, women are forced to abandon the workforce and are marginalized. Furthermore, as capital-intensive skills in industrial

productions expand, male labor becomes more desirable. Women return to the job force when their education improves and their worth in the labor market rises (Goldin, 1994).

Rate of Female LFP and Digitalization

The current study focused on micro rather than on macro level or cross-national level. Increased ICT penetration corresponds to higher female labor force participation, according to a panel regression of 48 African nations (Efobi et al., 2016). Research on Indo-Pacific zone was conducted. Increased internet use is related to 4/5th of the expansion in women's labor force participation in the Indo-Pacific from 2000-2016, using internet traffic as a digitalization indicator variable (Watson et al., 2018). This research differs from previous literature in that it focused on middle-income countries and covered all major parts of the globe. Furthermore, while other studies preferred using only one metric, this study employed two indicators of digitalization at the same time, to better understand its impact.

Digitalization effects women's employment through altering by a variety of means, the work force's dynamism and structure including increased access to better information, reduced time and mobility constraints, and increased demand for innovative jobs and market opportunities. These impacted stations have the potential to improve women's workforce participation. The positive effect of technology, on the other hand, is contingent on women having access to appropriate digital tools as well as digital skills and awareness.

Rising Accessibility of Information

The increased use of ICT in the sustenance of daily lives and occupations is a result of increased digitalization. Furthermore, digital technologies reduce information barricades, allowing women to easily have job prospects (Dettling, 2017). Digital technologies can make career finding, screening, and sharing of information between companies and employees easier by offering more information. Digital technologies could eliminate labor market bias by increasing the sharing of knowledge between genders, which would change mindsets over time (Nath, 2001). Due to increasing availability to knowledge, both genders may shift their perspectives on one another. Women tend to face less prejudice in the workplace due to having greater accessibility and businesses are more likely to hire women.

Mobility Restraints Accompanied with Reducing Time

The growth of cyberspace, broadband, and smart telecommunications has brought the world closer to one another, changing the working norms. Because digitalization makes the labor market more elastic and enhances the relaxation of work, it has an impact on women's workforce participation rates (Webster, 2014). Employment contracts, part-time labor, self-employment, and teleworking are becoming more common, giving women more opportunities to work. Women can work from home and on their own schedules due to the workforce's flexibility. Increased internet usage is linked to a 4.1%-point rise in married women participation in the workforce in the United States (Dettling, 2017). Women now have more internet access, allowing them to seek for more work opportunities. Women's increased participation in the workforce can be attributed to time savings in home tasks and an increase in telecommuting as internet practice grows (Dettling, 2017; Viollaz & Wrinkler, 2022). Women can now contribute to remote working without having to make decisions to work outside their home, making the labor market more flexible.

Rising Demand for New Jobs and Opportunities in Market

Having internet access in the US is related to increases in the employment rate by 1.8%, with a bigger benefit in countryside regions of roughly 2.2% (Atasoy, 2013). Moreover, increased internet access could reduce the unemployment rate (Labini & Bagues, 2007), while enhanced network exposure in South Africa improves work opportunities by 15% points, with women accounting for a significant part of this (Klonner & Nolen, 2010). A technological model based on skilled labor predicts that as the level of technology in the workforce rises, so would earnings and demand for skilled workers (Atasoy, 2013). Broadband technology and internet browsing are becoming more widely available which allows businesses to become more digitalized and technical, as well as make new economic prospects (Valberg, 2020). Resultantly, it would require specialized workers to supplement their digitalization efforts. Furthermore, due to digitalization, the workplace has become increasingly computerized, relying on new technologies to execute duties (Muro et al., 2017). Furthermore, digital technology can open new market potential for e-commerce. Entrepreneurs, particularly women, could benefit from digital technologies by expanding their enterprises and transactions across the local market. It gives women greater options to enter the market, increase their

company presence, particularly online, and make high wages (Sicat et al., 2020).

Digital Division of Persisting Gender

Digitalization is projected to improve female labor market involvement, those with necessary skills and tutoring would only be able to gain from these benefits. The current study based its argument on the assumption that the digital gender division still exists in community, with women lagging men in retrieving digital technologies, possessing digital skills, and gaining its benefits. In several middle-income nations, women lack the opportunity and sufficient skills and education to keep up with the digitalization trend. This puts them in peril and makes it hard for them to join the labor market. As the workforce depends more on the use of ICTs, so does the demand for experts (Atasoy, 2013). Women tend to join cheap or unskilled employment in middle-income countries. Digitalization facilitates unrestricted exchange of information, allowing them to easily learn about job openings. Women own 200 million fewer mobile phones than men over the world (Li & Lin, 2018). Resultantly, they fall behind in terms of knowing about opportunities or developing the necessary skills to join equally in the labor force.

Theoretical Framework

The current study is based on the following hypotheses. It combines internet use and broadband subscriptions as explanatory variables to better understand digitalization. Other indicators of digitalization include ICT investment and its intermediate goods and services, software investment, robotic use, online sales, and ICT experts. In the OECD framework, these factors are used to assess the digital intensity of industries. However, due to insufficient data on these variables, this study is unable to use some of them. Due to the availability of data from internet usage and subscriptions for broadband, this study would proceed to use them as indicators for the analysis. People would want internet and broadband access to obtain some information, particularly when looking for work. Resultantly, it is critical to use these parameters since they could be one of the elements influencing labor market results. When employing the internet or broadband as a measurement, there are certain potential drawbacks. These restrictions are highlighted in section 6. The current research intended to examine the consequences of digitalization on female level of participation since these results are relevant and related to females' economic empowerment

prospects.

Since mid-income countries have around 75% of the world's population and 62% of the world's deprived population, the study focused on them as selected countries. These groups contain a wide range of countries, each with its own economic, cultural, and religious characteristics. Since the year 2000, the increase of digitalization in middle-income countries has accelerated, with most economies continuing to grow significantly. Women, on the other hand, are still lagging when it comes to using digital gadgets. Women get internet access in 54% of low-and mid-income countries. Resultantly, this collection of nations offers a realistic problem to investigate.

The null hypothesis for this research is that digitalization does not affect female labor force participation in mid-income nations. To answer the two key questions, this research would test two hypotheses mentioned below.

H1: Increased internet usage would result in a reduction in female labor force participation.

H2: Increased subscriptions of broadband decreases the female labor force participation.

Earlier literature examined how digital technologies, such as the internet, mobile phones, and broadband can be used to empower women and enhance their labor market participation. The framework, on the other hand, hypothesizes the opposite because the literature disregards the society's persistent digital gender division. Women can only benefit from the positive effects of digital technology if they have necessary skills with an easy access to them. Since most of the women have limited access to technology, the current study suggested that increased digitalization may have a detrimental influence on female labor market outcomes in middle-income countries.

Research Methodology

Data

To examine the hypotheses, the current study conducted analysis by using a country-year panel dataset to determine if digitalization has an impact on labor market results. This study is conducted for a 23-year period, from 1995-2018. This timeframe is chosen because the rate of digitalization began to rise around 1995. Resultantly, this research argued that conducting

a study during this time frame was appropriate. The nations in the current study were chosen by using the World Bank's income group sorting. It selected 5 groups of economies from the mid-income countries category, which includes countries with GDP per capita ranging from $1,035 to $12,536. Due to lack of data, several countries are omitted from this research, the bulk of which are micro and smaller island nations. The data came primarily from WDI. Variables, descriptions, and their data sources are given in Table 1 in appendix.

Model Specifications

To minimize the omitted variable biases or other endogeneity difficulties, the main analysis of the study is conducted by using OLS along with a vector of added controlled factors.

Independent Variable

The independent variable in this study is digitalization. Internet usage and subscriptions of broadband are employed as digitalization indicators to conduct the current study.

Dependent Variables

The current study employed female labor force participation rate as the key variable for labor market outcomes.

Control Variables

The study included five control variables to eliminate biases caused by omitted variables. Confounding variables, such as rate of fertility, urban population proportion, female literateness, public expenditure as a GDP%, and GDP growth can influence the correlation and lead to a bias estimate. Therefore, it is crucial to control these variables. Economies with significant GDP growth or government spending may have increased internet and broadband usage. As countries progress, they continue investing more in its ICT infrastructure. Furthermore, increased GDP growth and increased public spending are linked to improved labor market results. Fertility rates are linked to an increase in labor supply, therefore adjusting for this would lessen the biases caused by these factors in the analysis.

Time Lag

To eliminate endogeneity and create an unbiased estimate, the regression model would lag all variables. Each variable would have one

year lag. Absence of lag could result in potentially skewed results. For instance, in most cases, internet usage has little effect in the current year. Internet data from 2006 would most likely have an impact a year or two later, in 2007 or 2008. Without lagging, the estimate's result could be influenced by earlier years' internet usage data. As a result, lagged variables caught this characteristic and are suitable for the study.

Regression Specifications

The current study conducted four analyses with OLS regression. Firstly, it attempted to investigate the association specified in H1. The specification of models is shown below:

$$female\_laborit=\alpha 1+\beta 1*internet\_usage(t-1)+\lambda 1*Zi(t-1)+i.year+i.country+eit \quad (1)$$

Female_laborit is the key variable that measures the female LFP rate (aging 15 years and above) for *i* country in time *t. Internet usage* is the share of the pupil with internet accessibility. *Zit* is the vector of 5 control variables. It permits the analysis to prevent any variation within and between years as well as between nations with differing cultural and social characteristics. $\beta 1$ is the chief estimator in finding the relationship in internet usage and female LFP rate.

The second model is used to estimate hypothesis 2.

$$female\_laborit=\alpha 2+\beta 2*broadband(t-1)+\lambda 2*Zi(t-1)+i.year+i.country+eit \quad (2)$$

Broadband is used to measure the number of people with fixed subscriptions for broadband per 100 populaces for *i* country in time *t*. $\beta 2$ is the estimate for a relationship among broadband subscription and female labor.

Threats to Internal Validity

It is extremely difficult to establish a causal association between digitalization and labor market results in case of female LFP and wage gap. Following are three perils that this research is aware of: (1) omitted variable bias might skew results and the relationship between labor market outcomes and digitalization can be influenced by a slew of other confounding factors. To overcome endogeneity and biases, this study employed numerous lagged approaches and controlled variables, (2) there is a chance that the

relationship that this study is looking for would reverse causation as the association that this research is looking for could go both ways, either digitalization affects labor market outcomes or vice versa. Usage of internet may influence female labor force participation rates, while it simultaneously could influence or drive internet usage. This vulnerability, however, can be mitigated by using the above-mentioned practice of lagging variables. Nonetheless, this research believed that digitalization influences labor market outcomes, (3) this research acknowledged that countries under consideration are varied societies with a wide range of cultural, economic, geographic, and socio-economic roots. By making 5 groups of countries having similar cultural, economic, geographic, and socio-economic roots, this study intended to reduce the existing risks to internal validity.

Results

This study used a total of 89 countries from across the globe and sorted them into five groups, based on the socio-economic structure of the society.

Table 1

Classification of Panel Data

Groups	Countries Included
1	Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Georgia, North Macedonia, Serbia, Ukraine, and Uzbekistan.
2	Algeria, Cote d'Ivoire, Egypt, Fiji, Jordan, Kazakhstan, Kyrgyz Republic, Lebanon, Mongolia, Morocco, Nigeria, and Turkmenistan.
3	Angola, Benin, Botswana, Cabo Verde, Cameroon, Comoros, Congo, Rep., Djibouti, Equatorial, Guinea, Eswatini, Gabon, Ghana. Jamaica, Kenya, Lao PDR, Lesotho, Moldova, Myanmar, Namibia, Nepal, Samoa, Senegal, Sri Lank, Suriname, Tanzania, Timor-Leste, Tonga, Tunisia, Zambia, and Zimbabwe.
4	Argentina, Belize, Bolivia, Cambodia, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Maldives, Mauritania, Nicaragua, Papua, New Guinea, Paraguay, Peru, Sao Tome and Principe, Venezuela, and Vietnam.

Groups	Countries Included
5	Bangladesh, Brazil, China, India, Indonesia, Iran Islamic Rep., Malaysia, Mexico, Pakistan, Philippines, Russian Federation, South Africa, Thailand, and Turkey.

Group 1

These are primarily Eastern European countries which previously belonged to the Union of Soviet Socialist Republics (USSR) or were closely related to it. Literature calls them transition economies. Under the USSR policies, they tend to have high school enrollment, evolving markets towards capitalist system, are closely related, and supported by EU and have low to medium capital per capita. They have special cultural and social norms which tend to be a mixture of EU, however, with greater religious following.

Group 2

This group consists of countries with relatively small economies and had long colonial and imperial influence. This influence has left some marks on the socio-economic structure of these countries, while their independence has also allowed impact of local customs on social norms. These countries have small GDPs and are open to trade.

Group 3

Countries in this group are mainly from Central Africa and some are from East Asia. Their economies are rather underdeveloped, with vast differences between urban and rural population. The educational and health outcomes are generally low as compared to the rest of the world. However, a small portion of the population meets and exceeds even the citizens of high-income nations. Countries in this group have similar colonial experiences and the colonial social structures have evolved in the same fashion.

Group 4

Countries in this group are primarily equatorial with rich natural green resources. Unlike fossil fuels, the green resources do not bring much foreign capital, however, they do anchor the economy in a certain way. All the countries in this group are considered periphery to some advance economy and are dependent on that high income country in terms of trade and support in international financial framework.

Group 5

This group comprises of countries with large populations and growing economies. Many of these countries have, at one point or another, been categorized as the future global growth engine. This includes BRICS countries as well as other future economies.

Discussion

The empirical work in the current study attempted to establish the causality between digitalization and female labor force participation. Digitalization is captured by two variables: internet usage, defined as the percentage of individuals with access to internet and broadband subscription, defined as the number of broadband subscriptions per 100 people. Each of these two variables reflect a distinct impact of digitalization. Access to broadband implies that necessary infrastructure is in place to supply it. Internet usage indicates that residents have access to the internet, albeit it may not be at a high speed, indicating a more rudimentary infrastructure. Since most of the countries in the sample are not OECD, they are expected to have a skew internet infrastructure. Secondly, since both digitalization variables are expected to be correlated, they cannot be a part of one regression in order to avoid the multi-collinearity issue. For each of these variables and each group of nations, a separate regression is opted.

The dataset is longitudinal, consisting of 89 countries for 23-year time period. The Hausman test is used to decide whether to adopt random effects or fixed effects model. The test results showed that for groups 1, 3, 4, and 5, fixed effect is a better model to use for both internet usage as well as broadband. The exception is group 2, where random effect is a better fit for both digitalization variables.

Table 2

Output of Fixed Effect Data Panel Regression Model

t-values	Groups									
Variables	1		2		3		4		5	
	Internet	BB	Internet	BB	Internet	BB	Internet	BB	Internet	BB
Linternet_usage	4.45		-0.40		-3.71		3.74		1.47	
Lbroadband		3.65		0.29		-3.32		2.71		0.30
Lfertility	6.97	0.71	-3.24	-0.40	-1.08	-1.10	-1.06	-1.37	-2.28	3.27
Lurban_pop	-6.94	-2.10	-1.18	-0.48	-0.47	1.28	3.65	3.00	-0.66	3.04
Lfemale_secondary	1.36	0.98	-0.15	-2.98	-0.84	-3.15	-1.55	-1.79	-5.90	-0.67
Lgdp_growth	0.70	0.95	-0.01	0.76	-2.24	0.14	1.28	1.73	0.22	1.03
Lgovt_expense	-3.40	-0.31	-0.38	1.20	-1.13	-1.51	2.88	-0.47	0.30	0.58

Table 3

Output of Random Effect Data Panel Regression Model

Coefficients	Groups									
Variables	1		2		3		4		5	
	Internet	BB	Internet	BB	Internet	BB	Internet	BB	Internet	BB
Linternet_usage	.031		-.005		-.048		.054		.084	
Lbroadband		.106		.038		-.222		.223		.052
Lfertility	4.808	1.025	-2.213	-.479	-.659	-.916	-.655	-1.349	-12.30	42.01
Lurban_pop	-.43	-.193	-.104	-.052	-.04	.189	.24	.286	-.519	2.422
Lfemale_secondary	.036	.034	-.004	-.103	-.018	-.077	-.034	-.044	-.322	-.085
Lgdp_growth	.018	.029	-.001	.066	-.092	.006	.055	.08	.007	.106
Lgovt_expense	-.208	-.024	-.038	.167	-.03	-.035	.227	-.054	.044	.097

The variable, that is, internet usage is a significant regressor in models 1, 3, and 4 at alpha value of 0.01 and is significant for model 5 at alpha value of 0.15. Broadband is a significant regressor in models 1, 3, and 4. Among the control variables, lagged GDP growth is not significant except for group 3. This is because countries in group 3 are mostly central African and other low GDP countries. Therefore, an increase in GDP growth changes the socio-economic dimension significantly. Otherwise, GDP growth is expected to affect a socio-economic variable, such as female labor force participation only over a long horizon. Lagged female secondary education is significant where education levels are low. Therefore, a change in secondary education levels affect female labor force participation rates in countries with large number of populations without secondary education. All other variables are generally significant.

The primary variable of interest and log of internet usage is significant and is positively correlated with the female labor force participation rates for groups 1, 4, and 5. However, it has a negative value for groups 2 and 3 (note: group 2 is using random effect, while the rest use fixed effects). Group 2 coefficient for internet usage is insignificant. This shows that as the internet penetration increases in this group of countries, female labor force participation rate increases. Specifically, for instance, the coefficient of 0.031 shows that a 1% change in the internet users in this group of countries increases the female labor force participation rate by 0.031% of the female labor force participation rate.

For broadband, the coefficients are always positive. This is in line with the theoretical discussion earlier that an increase in provision of high speed internet increases the employability of the population, thus leading to an increase in the labor force participation rate. One key finding is that this holds for all the group of countries, thereby indicating that broadband provision helps to increase female labor force participation rates irrespective of the structure of the society or income levels.

The control variables are also significant except female secondary school education and lagged GDP growth. This group of countries comprises of nations with high secondary school enrollment and graduation. Thus, the variable does not affect female labor force participation rate since most females are already educated to this level. Similarly, the GDP growth and the government expense are not significant since the effect of these on labor force participation takes a while and is not a determinant for the time

horizon of this study.

Countries Group 1

Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Georgia, North Macedonia, Serbia, Ukraine and Uzbekistan

Dependent variable: Female Labor force participation rate

Independent Variable of interest: Percentage of individuals with access to internet %

Table 4

Regression Coefficients for Predictors of Digitalization Concern

Female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Linternet_usage	.031	.007	4.45	0	.017	.045	***
Lfertility	4.808	.69	6.97	0	3.444	6.172	***
Lurban_pop	-.43	.062	-6.94	0	-.553	-.308	***
Lfemale_secondary	.036	.026	1.36	.176	-.016	.088	
Lgdp_growth	.018	.025	0.70	.483	-.032	.067	
Lgovt_expense	-.208	.061	-3.40	.001	-.33	-.087	***
Constant	66.317	3.721	17.82	0	58.958	73.676	***
Mean dependent var		49.744	*SD* dependent var			6.219	
R-squared		0.539	Number of obs			150	
F-test		26.105	Prob > *F*			0.000	
Akaike crit. (AIC)		505.547	Bayesian crit. (BIC)			526.622	

Note. *** $p<.01$.

Table 5

Regression Results

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Linternet_usage	.029	.007	4.00	0	.015	.043	***
Lfertility	4.89	.71	6.89	0	3.498	6.282	***
Lurban_pop	-.403	.063	-6.45	0	-.526	-.281	***
Lfemale_secondary	.033	.027	1.23	.22	-.02	.087	
Lgdp_growth	.016	.026	0.63	.529	-.034	.067	
Lgovt_expense	-.214	.063	-3.39	.001	-.338	-.09	***
Constant	67.087	4.346	15.44	0	58.569	75.604	***
Mean dependent var		49.744	*SD* dependent var			6.219	
Overall *R*-squared		0.055	Number of obs			150	
Chi-square		146.068	Prob > chi2			0.000	
R-squared within		0.538	*R*-squared between			0.081	

Note. *** $p<.01$.

Table 6

Hausman (1978) Specification Test

	Coef.
Chi-square test value	15.185
p-value	.019

Dependent variable: Female Labor force participation rate

Independent variable of interest: Number of broadband subscriptions per 100 people

Table 7

Regression Coefficients for Predictors of Digitalization Concern

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Lbroadband	.106	.029	3.65	0	.048	.163	***
Lfertility	1.025	1.441	0.71	.479	-1.837	3.887	
Lurban_pop	-.193	.092	-2.10	.039	-.376	-.01	**
Lfemale_secondary	.034	.035	0.98	.33	-.035	.104	
Lgdp_growth	.029	.031	0.95	.344	-.032	.09	
Lgovt_expense	-.024	.08	-0.31	.761	-.182	.134	
Constant	55.481	4.996	11.10	0	45.554	65.407	***
Mean dependent var		49.445	*SD* dependent var			4.926	
R-squared		0.230	Number of obs			105	
F-test		4.473	Prob > *F*			0.000	
Akaike crit. (AIC)		305.331	Bayesian crit. (BIC)			323.908	

Note. *** $p<.01$, ** $p<.05$.

Table 8

Regression Results

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Lbroadband	.087	.029	2.96	.003	.029	.145	***
Lfertility	1.61	1.392	1.16	.247	-1.119	4.34	
Lurban_pop	-.113	.083	-1.36	.175	-.277	.05	
Lfemale_secondary	.035	.035	0.99	.321	-.034	.104	
Lgdp_growth	.032	.032	0.99	.323	-.031	.095	
Lgovt_expense	-.054	.081	-0.67	.505	-.213	.105	
Constant	50.305	5.087	9.89	0	40.334	60.275	***
Mean dependent var		49.445	*SD* dependent var			4.926	
Overall *R*-squared		0.124	Number of obs			105	
Chi-square		24.615	Prob > chi2			0.000	
R-squared within		0.219	*R*-squared between			0.108	

Note. *** $p<.01$.

Table 9

Hausman (1978) Specification Test

	Coef.
Chi-square test value	15.494
p-value	.017

Countries Group 2

Algeria, Cote d'Ivoire, Egypt, Fiji, Jordan, Kazakhstan, Kyrgyz Republic, Lebanon, Mongolia, Morocco, Nigeria and Turkmenistan.

Dependent variable: Female Labor Force Participation Rate

Independent variable of interest: Percentage of Individuals with Access to Internet in %

Table 10

Regression Coefficients for Predictors of Digitalization Concern

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Linternet_usage	-.006	.014	-0.45	.654	-.033	.021	
Lfertility	-2.189	.696	-3.15	.002	-3.566	-.813	***
Lurban_pop	-.088	.09	-0.98	.328	-.266	.09	
Lfemale_secondary	-.007	.027	-0.26	.798	-.059	.046	
Lgdp_growth	.001	.06	0.02	.984	-.117	.119	
Lgovt_expense	-.027	.102	-0.26	.794	-.229	.175	
Constant	49.822	5.888	8.46	0	38.175	61.47	***
Mean dependent var		36.879	*SD* dependent var			18.256	
R-squared		0.094	Number of obs			147	
F-test		2.270	Prob > *F*			0.007	
Akaike crit. (AIC)		611.676	Bayesian crit. (BIC)			632.609	

Note. *** $p<.01$.

Table 11

Regression Results

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Linternet_usage	-.005	.013	-0.40	.691	-.032	.021	
Lfertility	-2.213	.684	-3.24	.001	-3.553	-.872	***
Lurban_pop	-.104	.088	-1.18	.237	-.276	.068	
Lfemale_secondary	-.004	.026	-0.15	.881	-.055	.047	
Lgdp_growth	-.001	.059	-0.01	.989	-.117	.115	
Lgovt_expense	-.038	.101	-0.38	.706	-.236	.16	

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Constant	52.322	8.856	5.91	0	34.964	69.679	***
Mean dependent var		36.879	*SD* dependent var			18.256	
Overall *R*-squared		0.048	Number of obs			147	
Chi-square		14.031	Prob > chi2			0.029	
R-squared within		0.094	*R*-squared between			0.035	

Note. *** $p<.01$.

Table 12

Hausman (1978) Specification Test

	Coef.
Chi-square test value	3.865
p-value	.695

Dependent variable: Female Labor Force Participation Rate

Independent variable of interest: Number of Broadband Subscriptions Per 100 People

Table 13

Regression Coefficients for Predictors of Digitalization Concern

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Lbroadband	.024	.136	0.18	.858	-.246	.295	
Lfertility	-.342	1.249	-0.27	.785	-2.826	2.142	
Lurban_pop	-.016	.112	-0.14	.887	-.24	.208	
Lfemale_secondary	-.11	.035	-3.10	.003	-.18	-.039	***
Lgdp_growth	.072	.087	0.82	.412	-.102	.245	
Lgovt_expense	.194	.141	1.38	.171	-.086	.474	
Constant	44.708	8.305	5.38	0	28.186	61.23	***
Mean dependent var		37.559	*SD* dependent var			18.051	
R-squared		0.168	Number of obs			98	
F-test		2.750	Prob > *F*			0.002	
Akaike crit. (AIC)		393.488	Bayesian crit. (BIC)			411.582	

Note. *** $p<.01$.

Table 14

Regression Results

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Lbroadband	.038	.134	0.29	.774	-.225	.302	
Lfertility	-.479	1.202	-0.40	.69	-2.835	1.877	
Lurban_pop	-.052	.108	-0.48	.633	-.264	.161	

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Lfemale_secondary	-.103	.035	-2.98	.003	-.171	-.035	***
Lgdp_growth	.066	.086	0.76	.446	-.104	.235	
Lgovt_expense	.167	.139	1.20	.228	-.105	.439	
Constant	48.149	10.227	4.71	0	28.105	68.194	***
Mean dependent var		37.559	*SD* dependent var			18.051	
Overall R-squared		0.001	Number of obs			98	
Chi-square		16.405	Prob > chi2			0.012	
R-squared within		0.166	*R*-squared between			0.004	

Note. *** $p<.01$.

Table 15

Hausman (1978) Specification Test

	Coef.
Chi-square test value	4.824
p-value	.567

Countries Group 3

Angola , Benin, Botswana, Cabo Verde, Cameroon, Comoros, Congo, Rep., Djibouti, Equatorial, Guinea, Eswatini, Gabon, Ghana. Jamaica, Kenya, Lao PDR, Lesotho, Moldova, Myanmar, Namibia, Nepal, Samoa, Senegal, Sri Lank, Suriname, Tanzania, Timor-Leste, Tonga, Tunisia, Zambia and Zimbabwe.

Dependent variable: Female Labor force participation rate

Independent variable of interest: Percentage of individuals with access to internet in %

Table 16

Regression Coefficients for Predictors of Digitalization Concern

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Linternet_usage	-.048	.013	-3.71	0	-.074	-.023	***
Lfertility	-.659	.611	-1.08	.282	-1.861	.544	
Lurban_pop	-.04	.084	-0.47	.639	-.206	.127	
Lfemale_secondary	-.018	.022	-0.84	.402	-.062	.025	
Lgdp_growth	-.092	.041	-2.24	.026	-.173	-.011	**
Lgovt_expense	-.03	.026	-1.13	.26	-.081	.022	
Constant	63.253	4.856	13.03	0	53.694	72.812	***
Mean dependent var		56.702	*SD* dependent var			16.617	

R-squared	0.091	Number of obs	316
F-test	4.685	Prob > *F*	0.000
Akaike crit. (AIC)	1374.122	Bayesian crit. (BIC)	1400.412

Note. *** $p<.01$, ** $p<.05$.

Table 17

Regression Results

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Linternet_usage	-.046	.013	-3.53	0	-.072	-.021	***
Lfertility	-.578	.592	-0.98	.329	-1.739	.583	
Lurban_pop	-.051	.074	-0.68	.494	-.195	.094	
Lfemale_secondary	-.019	.022	-0.89	.372	-.061	.023	
Lgdp_growth	-.091	.041	-2.21	.027	-.172	-.01	**
Lgovt_expense	-.029	.026	-1.09	.275	-.08	.023	
Constant	62.246	5.461	11.40	0	51.543	72.949	***
Mean dependent var		56.702	*SD* dependent var			16.617	
Overall *R*-squared		0.078	Number of obs			316	
Chi-square		28.456	Prob > chi2			0.000	
R-squared within		0.090	*R*-squared between			0.058	

Note. *** $p<.01$, ** $p<.05$.

Table 18

Hausman (1978) Specification Test

	Coef.
Chi-square test value	10.506
p-value	.105

Dependent Variable: Female Labor Force Participation Rate

Independent Variable of Interest: Number of Broadband Subscriptions Per 100 People

Table 19

Regression Results

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Lbroadband	-.222	.067	-3.32	.001	-.354	-.09	***
Lfertility	-.916	.836	-1.10	.275	-2.567	.734	
Lurban_pop	.189	.148	1.28	.204	-.103	.481	
Lfemale_secondary	-.077	.024	-3.15	.002	-.125	-.029	***
Lgdp_growth	.006	.041	0.14	.893	-.076	.087	
Lgovt_expense	-.035	.023	-1.51	.134	-.08	.011	
Constant	58.146	7.457	7.80	0	43.43	72.862	***

Mean dependent var	56.800	*SD* dependent var	15.935
R-squared	0.112	Number of obs	211
F-test	3.744	Prob > *F*	0.000
Akaike crit. (AIC)	819.242	Bayesian crit. (BIC)	842.705

Note. *** $p<.01$.

Table 20

Regression Results

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Lbroadband	-.221	.068	-3.27	.001	-.354	-.089	***
Lfertility	-.888	.762	-1.17	.244	-2.381	.605	
Lurban_pop	.098	.107	0.92	.36	-.112	.309	
Lfemale_secondary	-.068	.023	-3.01	.003	-.112	-.024	***
Lgdp_growth	0	.042	0.00	.999	-.082	.082	
Lgovt_expense	-.032	.023	-1.40	.162	-.077	.013	
Constant	60.265	6.718	8.97	0	47.098	73.432	***
Mean dependent var		56.800	*SD* dependent var			15.935	
Overall *R*-squared		0.015	Number of obs			211	
Chi-square		21.844	Prob > chi2			0.001	
R-squared within		0.109	*R*-squared between			0.020	

Note. *** $p<.01$.

Table 21

Hausman (1978) Specification Test

	Coef.
Chi-square test value	11.138
p-value	.084

Countries Group 4

Argentina, Belize, Bolivia, Cambodia, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Maldives, Mauritania, Nicaragua, Papua, New Guinea, Paraguay, Peru, Sao Tome and Principe, Venezuela, and Vietnam.

Dependent variable: Female Labor Force Participation Rate

Independent variable of interest: percentage of Individuals with Access to Internet in %

Table 22

Regression Coefficients for Predictors of Digitalization Concern

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Linternet_usage	.054	.014	3.74	0	.025	.082	***
Lfertility	-.655	.615	-1.06	.288	-1.867	.556	
Lurban_pop	.24	.066	3.65	0	.111	.37	***
Lfemale_secondary	-.034	.022	-1.55	.121	-.078	.009	
Lgdp_growth	.055	.043	1.28	.201	-.03	.141	
Lgovt_expense	.227	.079	2.88	.004	.072	.382	***
Constant	33.652	4.938	6.81	0	23.932	43.372	***
Mean dependent var		48.839	*SD* dependent var			10.825	
R-squared		0.312	Number of obs			316	
F-test		21.880	Prob > *F*			0.000	
Akaike crit. (AIC)		1448.513	Bayesian crit. (BIC)			1474.803	

Note. *** $p<.01$.

Table 23

Regression Results

female_labor	Coef.	St.Err.	t-value	p-value	[95% Conf Interval]		Sig
Linternet_usage	.061	.014	4.27	0	.033	.089	***
Lfertility	-.846	.62	-1.36	.172	-2.062	.369	
Lurban_pop	.152	.061	2.48	.013	.032	.272	**
Lfemale_secondary	-.028	.022	-1.25	.21	-.072	.016	
Lgdp_growth	.054	.044	1.24	.217	-.032	.141	
Lgovt_expense	.182	.079	2.30	.021	.027	.337	**
Constant	43.006	5.178	8.31	0	32.857	53.154	***
Mean dependent var		48.839	*SD* dependent var			10.825	
Overall *R*-squared		0.001	Number of obs			316	
Chi-square		117.782	Prob > chi2			0.000	
R-squared within		0.307	*R*-squared between			0.148	

Note. *** $p<.01$, ** $p<.05$.

Table 24

Hausman (1978) Specification Test

	Coef.
Chi-square test value	16.691
p-value	.01

Dependent variable: Female Labor Force Participation Rate

Independent variable of interest: Number of Broadband Subscriptions Per 100 People

Table 25

Regression Coefficients for Predictors of Digitalization Concern

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Lbroadband	.223	.082	2.71	.007	.061	.384	***
Lfertility	-1.349	.987	-1.37	.173	-3.295	.597	
Lurban_pop	.286	.095	3.00	.003	.098	.474	***
Lfemale_secondary	-.044	.025	-1.79	.075	-.093	.005	*
Lgdp_growth	.08	.046	1.73	.084	-.011	.171	*
Lgovt_expense	-.054	.114	-0.47	.639	-.278	.171	
Constant	38.137	8.04	4.74	0	22.286	53.988	***
Mean dependent var		50.132	SD dependent var			9.995	
R-squared		0.222	Number of obs			230	
F-test		9.781	Prob > *F*			0.000	
Akaike crit. (AIC)		1005.789	Bayesian crit. (BIC)			1029.855	

Note. *** $p<.01$, * $p<.1$.

Table 26

Regression Results

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Lbroadband	.289	.08	3.60	0	.131	.446	***
Lfertility	-2.065	.976	-2.12	.034	-3.978	-.152	**
Lurban_pop	.126	.076	1.66	.097	-.023	.275	*
Lfemale_secondary	-.039	.025	-1.54	.123	-.089	.011	
Lgdp_growth	.079	.048	1.65	.098	-.015	.174	*
Lgovt_expense	-.163	.111	-1.47	.141	-.381	.054	
Constant	51.619	6.859	7.53	0	38.176	65.061	***
Mean dependent var		50.132	*SD* dependent var			9.995	
Overall *R*-squared		0.061	Number of obs			230	
Chi-square		52.473	Prob > chi2			0.000	
R-squared within		0.208	R-squared between			0.060	

Note. *** $p<.01$, ** $p<.05$, * $p<.1$

Table 27

Hausman (1978) Specification Test

	Coef.
Chi-square test value	23.231
p-value	.001

Countries Group 5

Bangladesh, Brazil, China, India, Indonesia, Iran Islamic Rep.,

Malaysia, Mexico, Pakistan, Philippines, Russian Federation, South Africa, Thailand, and Turkey.

Dependent variable: Female Labor Force Participation Rate

Independent variable of interest: Percentage of Individuals with Access to Internet in %

Table 28

Regression Coefficients for Predictors of Digitalization Concern

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Linternet_usage	.084	.058	1.47	.155	-.034	.203	
Lfertility	-12.306	5.407	-2.28	.031	-23.42	-1.192	**
Lurban_pop	-.519	.784	-0.66	.514	-2.131	1.093	
Lfemale_secondary	-.322	.055	-5.90	0	-.434	-.21	***
Lgdp_growth	.007	.032	0.22	.824	-.058	.072	
Lgovt_expense	.044	.148	0.30	.77	-.261	.349	
Constant	126.041	52.959	2.38	.025	17.181	234.901	**
Mean dependent var		46.411	*SD* dependent var			16.736	
R-squared		0.686	Number of obs			36	
F-test		9.477	Prob > *F*			0.000	
Akaike crit. (AIC)		144.249	Bayesian crit. (BIC)			155.333	

Note. *** $p<.01$, ** $p<.05$.

Table 29

Regression Results

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Linternet_usage	-.081	.04	-2.03	.042	-.159	-.003	**
Lfertility	-17.005	2.354	-7.23	0	-21.618	-12.392	***
Lurban_pop	-.582	.075	-7.81	0	-.729	-.436	***
Lfemale_secondary	-.268	.081	-3.32	.001	-.427	-.11	***
Lgdp_growth	.09	.053	1.68	.094	-.015	.194	*
Lgovt_expense	-.611	.182	-3.36	.001	-.967	-.254	***
Constant	153.045	11.111	13.77	0	131.268	174.821	***
Mean dependent var		46.411	*SD* dependent var			16.736	
Overall *R*-squared		0.968	Number of obs			36	
Chi-square		877.333	Prob > chi2			0.000	
R-squared within		0.176	*R*-squared between			0.989	

Note. *** $p<.01$, ** $p<.05$, * $p<.1$.

Table 30

Hausman (1978) Specification Test

	Coef.
Chi-square test value	21.739
p-value	0

Dependent variable: Female Labor Force Participation Rate

Independent Variable of interest: Number of Broadband Subscriptions Per 100 People

Table 31

Regression Coefficients for Predictors of Digitalization Concern

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Lbroadband	.052	.173	0.30	.769	-.321	.425	
Lfertility	42.01	12.83	3.27	.006	14.291	69.728	***
Lurban_pop	2.422	.798	3.04	.01	.699	4.145	***
Lfemale_secondary	-.085	.127	-0.67	.517	-.36	.191	
Lgdp_growth	.106	.103	1.03	.32	-.116	.328	
Lgovt_expense	.097	.168	0.58	.573	-.265	.459	
Constant	-159.463	62.942	-2.53	.025	-295.4	-23.48	**
Mean dependent var		49.301	*SD* dependent var			12.059	
R-squared		0.830	Number of obs			22	
F-test		10.560	Prob > *F*			0.000	
Akaike crit. (AIC)		80.685	Bayesian crit. (BIC)			88.322	

Note. *** $p<.01$, ** $p<.05$.

Table 32

Regression Results

female_labor	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf Interval]		Sig
Lbroadband	.238	.154	1.55	.122	-.064	.54	
Lfertility	-14.095	2.676	-5.27	0	-19.341	-8.849	***
Lurban_pop	-.667	.087	-7.68	0	-.837	-.497	***
Lfemale_secondary	-.255	.091	-2.79	.005	-.434	-.076	***
Lgdp_growth	.214	.152	1.40	.161	-.085	.512	
Lgovt_expense	-.025	.242	-0.10	.919	-.499	.45	
Constant	132.848	13.398	9.92	0	106.588	159.108	***
Mean dependent var		49.301	*SD* dependent var			12.059	
Overall *R*-squared		0.976	Number of obs			22	
Chi-square		619.730	Prob > chi2			0.000	
R-squared within		0.545	*R*-squared between			1.000	

Note. *** $p<.01$.

Table 33
Hausman (1978) Specification Test

	Coef.
Chi-square test value	9.453
p-value	.009

Conclusion and Policy Recommendations

In contrast to previous research, the current study investigated that the internet usage in middle-income countries is linked to lower female labor force participation rates. This study provides countries considerable latitude in terms of prioritizing policies to deal with the effects of digitalization, as well as looking back on their commitments to the 2030 Development Agenda. Resultantly, politicians can develop inclusive and successful policies that benefit their citizens as their economies grow towards industrialization.

The current study concluded that digitalization is a double-edged sword as technology can have both beneficial and adverse effects on women's labor market results. Potential regulations should recognize these ambiguous effects and strive to implement effective and gender-sensitive strategies that improve female accessibility to digital technologies while minimizing the negative consequences of those technologies. Women benefit from digital technologies because they allow them to leapfrog and enhance their prospects in community (Martin, 2018). It also emphasizes that digital technology is not a cure for all challenges of gender inequality (Sicat et al. 2020). However, correctly utilizing digital technology could improve society and help to close the digital gender gap, allowing women to make more money and participate in the labor force.

Policymakers must prioritize to overcome the gender digital disparity and increase women's access to the internet as well as other forms of digital connectivity, such as mobile phones and broadband. Women's access to technology, ICT skills, and literacy can be improved by gender-sensitive policy. Increasing women's access to the internet, cellular phones, or other digital technologies is critical in closing the digital gender gap and retreating the negative effects that technology could have on women. Counting women in technology access allows them to reap the profits of those technologies and fully contribute to society. Using digital technologies can provide women with a plethora of advantages (Martin, 2018).

Women who are skilled and literate digitally, are better suited and prepared to engage in the economy as it becomes more digitally connected (Watson et al., 2018). Rudimentary ICT skills training is critical in equipping women with the information they need to steer the digital world. This refers to how to access the internet and the digital systems in context of digital money, job hunting, and online education valuation. Because women are unconfident to use digital platforms, they use fewer digital services than men (Martin, 2018).

Work-life balance and other welfare support policies are also important because of digitalization. Digital platforms should be used to increase women's participation in the labor market while also maintaining job worth (Martin, 2018). Equal benefits for both gender labor market possibilities should continue to be available. Technological advancements may lead to more flexible work schedules or remote working hours. Resultantly, regulations that give social protection to workers, particularly women, are needed. It also applies to social protection measures, particularly while using online platforms to look for job, where women should be protected from any cyber bullying or online harassment that may occur As a result, a better law is required. Gender equality should be a priority in social protection policy.

Limitations

Many limitations exist in the current study that future studies would be able to remedy this issue.

Firstly, the digitalization measures adopted posed a constraint. Due to randomness of the internet and broadband, research has shown that using them as predictors is challenging. Internet users tend to be causal to labor market participation since they're not selected randomly (Dettling, 2017). Resultantly, future studies may choose to employ a variety of indicators to proxy digitalization. ICT funding is required to track countries' digitalization adoption, ICT professionals are required to assess ICT training, and resolute technology adoption is an adequate measure of a country's or sector's vulnerability to digitalization.

Furthermore, there may be a causality restriction in establishing the association investigated in the current study. An instrumental variable (IV) technique could be used to create a more complicated design and IV approach could be applied to test the causality between female participation

rate and digitalization. Resultantly, these variances may have a varied influence on female labor force. Using regime type as an IV in a future study could help researchers figure out how regime type affects digitalization. This can help determine whether digitalization has an impact on labor market outcomes. However, other confounding factors may influence regime type, therefore if this variable is employed, more research would be needed. Furthermore, the level of internet access is a useful instrumental variable. It provides a valuable causality infer approach to determine how internet privacy influences its usage or broadband internet and how digitalization influences employment rates. Finally, terrain or a geographical characteristic can be used as an instrumental variable. The use of digital technology, particularly digital communication and telecommunication can be influenced by the terrain. Mountain and topography might obstruct the access of digital devices, so this is another important variable to use in determining causality.

References

Atasoy, H. (2013). The effects of broadband internet expansion on labor market outcomes. *ILR review*, *66*(2), 315–345. https://doi.org/10.1177/001979391306600202

Boserup, E. (2007). *Woman's role in economic development*. Earthscan.

Chapco-Wade-Safina, C. (2018, October 21). *Digitization, digitalization, and digital transformation: What's the difference.* Medium. https://colleenchapcowadesafina.medium.com/digitization-digitalization-and-digital-transformation-whats-the-difference-eff1d002fbdf

Dettling, L. J. (2017). Broadband in the labor market: The impact of residential high-speed internet on married women's labor force participation. *ILR Review*, *70*(2), 451–482. https://doi.org/10.1177/0019793916644721

Efobi, U., Tanankem, B., & Asongu, S. (2016). *Technological advancement and the evolving gender identities: A focus on the level of female economic participation in Sub-Saharan Africa* (African Governance and Development Institute WP/16/045). http://dx.doi.org/10.2139/ssrn.2885739

Gupta, S., Motlagh, M., & Rhyner, J. (2020). The digitalization

sustainability matrix: A participatory research tool for investigating digitainability. *Sustainability*, *12*(21), Article e9283. https://doi.org/10.3390/su12219283

Goldin, C. (1994). The U-shaped female labor force function in economic development and economic history. In P.T. Schultz (Ed.), *Investment in women's human capital and economic development* (pp. 61–90). University of Chicago Press.

Klonner, S., & Nolen, P. J. (2010). *Cell phones and rural labor markets: Evidence from South Africa.* Proceedings of the German Development Economics Conference¸ Hanover, Germany.

Li, L., & Lin, T. T. (2018). Examining how dependence on smartphones at work relates to Chinese employees' workplace social capital, job performance, and smartphone addiction. *Information Development*, *34*(5), 489–503. https://doi.org/10.1177/0266666917721735

Labini, M. S., & Bagues, M. F. (2007). *Do on-line labor market intermediaries matter? The impact of Almalaurea on the university-to-work transition* (National Bureau of Economic Research. Working Paper No. 13621). http://www.nber.org/papers/w13621

Martin, J. P. (2018). *Skills for the 21st century: Findings and policy lessons from the OECD survey of adult skills* (OECD Working Paper No. 166). https://doi.org/10.1787/96e69229-en

Muro, M., Liu, S., Whiton, J., & Kulkarni, S. (2017). *Digitalization and the American workforce. Brooking Institutions.* https://www.brookings.edu/wp-content/uploads/2017/11/mpp_2017nov15_digitalization_full_report.pdf

Nath, V. (2001). Empowerment and governance through information and communication technologies: Women's perspective. *The International Information & Library Review*, *33*(4), 317–339. https://doi.org/10.1006/iilr.2001.0175

Psacharopoulos, G., & Tzannatos, Z. (1989). Female labor force participation: An international perspective. *The World Bank Research Observer*, *4*(2), 187–201. https://doi.org/10.1093/wbro/4.2.187

Pampel, F. C., & Tanaka, K. (1986). Economic development and female

labor force participation: A reconsideration. *Social forces*, *64*(3), 599–619. https://doi.org/10.1093/sf/64.3.599

Sicat, M., Xu, A., Mehetaj, E., Ferrantino, M., & Chemutai, V. (2020). *Leveraging ICT Technologies in Closing the Gender Gap* (World Bank Working Paper*)*. http://hdl.handle.net/10986/33165

Sinha, J. N. (1965). *Dynamics of female participation in economic activity in a developing economy*. Proceedings of the World Population Conference, Belgrade, Serbia.

Valberg, S. (2020). ICT, gender, and the labor market: A cross-country analysis. In D. Maiti, F. Castellacci & A. Melchior (Eds.), *Digitalisation and development: Issues for india and beyond* (pp. 375–405). Springer. https://doi.org/10.1007/978-981-13-9996-1_15

Viollaz, M., & Winkler, H. (2022). Does the internet reduce gender gaps? The case of Jordan. *The Journal of Development Studies*, *58*(3), 436–453. https://doi.org/10.1080/00220388.2021.1965127

Watson, T., Corliss, M., & Le, M. (2018). Digitalisation and women's workforce participation in the Indo-Pacific. *Australian Journal of Labour Economics*, *21*(1), 45–74.

Webster, J. (2014). *Shaping women's work: Gender, employment and information technology*. Routledge.

Appendix

Table 1

Variables, Descriptions and Source

Variables	Descriptions	Sources
Internet Usage	Percentage of individuals with access to internet in %	WDI
Broadband	Measure as subscription per 100 people	WDI
Female Labor	Measure female labor participation rate in %	WDI
Fertility	Measure as Total births per women	WDI
Urban Population	Measure as % those live in urban areas of total population	WDI
Female Secondary	Gross enrollment of female student in secondary education in %	WDI
GDP Growth	Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S.	WDI
Govt Expense	Measure as % of GDP	WDI