



Examining the Impact of Information and Communication Technologies on Female Economic Participation in Pakistan

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Abstract *This study is an attempt to investigate the impact of information and communication technologies (ICTs) development on the participation of women in economic activities in Pakistan. Data for the period 1991-2017 was used for this research work and regressed on female economic involvement and ICTs development and another set of control variables like GDP, FDI and trade liberalization. Data sources are the WDI, IFS, and ESP. Johansen cointegration test, VECM and Granger causality tests were used to estimate data. Estimation techniques were applied after checking the properties of time series data. Results indicate the positive and significant relationship of dependent variable female economic participation and independent variables ICTs development and macro-economic variables in the long run. The study findings indicate that female economic participation has increased with the increase in ICTs in Pakistan. However, the rate of women's economic participation was not found as increasing as in other developed countries, and it is not as rapid as technology developed in the last decade.*

Key Words: ICTs, Female Participation, GDP, FDI, Developing Countries, Pakistan

JEL Classification:

Introduction

Information and communication technologies as a complex and heterogeneous set of goods, applications and service used for producing, distributing, processing, and transforming information (Marcelle, 2002). Definition of information and communication technologies are as varied as variations occur in technology. Mbatha (2013) defined it “ICTs enable the handling of information and facilitate different forms of communication between human actors’ human beings and electronic systems and between electronic systems. Mobile cellular subscriber and internet users’ blow out quicker than all prior technologies in creating economic resources. In developing countries, most of the households have entree to cellular phones and the internet more than clean water and electricity. The number of internet users and a number of mobile

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phone users have increased three times, only during the last decades, i.e. 1 billion users in 2005 and 3.5 billion users in 2015 ([Valberg, 2017](#)).

It is hard to realize the aim of economic development without technological growth. Human progress cannot occur without technological modernization and diffusion, it is unlikely that technology affects all groups and individuals equally, and nations can't enjoy the fruits of ICTs till all the groups and individuals of society have equal access to all IT resources ([Efobi, Tanankem, & Asongu, 2018](#)). Pakistan has listed a high growth in internet penetration rate according to IT&U, there are twenty million users of internet in Pakistan, and it is ranked 27th largest country in the world in internet penetration. The government of Pakistan spend R.S 4.6 billion on ICTs projects in the fiscal year 2012-2013 and emphasize infrastructure, e-governance and human resource.

The goals of sustainable development by world leaders accentuate the status of empowering women and girls by promoting women's right to use land and productive resources and ICTs (women's economic participation and empowerment in Pakistan Status report 2016). The WEF measuring the progress of ICTs Pakistan ranked 111th among 144 countries ([Dutta & Mia, 2011](#)). The purpose of this research was to identify whether ICTs advancement has an impact on Female economic participation in Pakistan, whether female participation growth technology advancement and the study also identify the effects of other macro-economic variables like trade liberalization, GDP and FDI on female economic participation. The study is first of its kind in Pakistan as per the researchers' knowledge. The results can have substantial policy implication to increase female workforce participation and food for thought for future policy makers and it can be used basis for future research.

For this study time series data of period from 1990-2018 was analysed. Different estimation techniques like JCT, VECM, and GCT were employed to measure the effect of information technology on women economic contribution. The main dependent variable is women economic participation which is calculated by female labour force participation rate identified by World Bank (2018). Independent variable ICTs advancement is measured by two main indicators first internet users per 100 people and second cellular phone users per 100 people. These variables are important for technology advancement in developing countries ([Consoli, 2012](#)). A set of controlled variables is used to handle the empirical results which includes trade liberalization, per capita income and FDI. Trade liberalization is calculated as import+ export/GDP. Data source of all variables is WDI from period 1991 to 2018. The estimation techniques used to check significant relationship of variables are Johansen cointegration test, VECM (vector error correction model) and Granger causality test these techniques used after checking the stationarity of data. As data was not stationary at level thus unit root test was run and stationarity achieved at first difference and when all variables are stationary at first difference, Johansen cointegration test was applied for checking long run relationship and for short run Granger causality test was used.

Literature Review

[Oriogun, Abaye, Forteta, and Shorunke \(2015\)](#) expressed the role of ICTs in the lives of poor and found that ICTs assist women role in economic growth. [Bonder \(2002\)](#)

investigated the major gaps in access to ICTs in Latin America. The study present basic information on expansion of information and communication technology in region and suggest that equal access of both gender to ICTs will lead to economic growth and development.

[Webb and Buskens \(2014\)](#) organize an extensive research project based on primary field survey. They found how the women can utilize ICTs for their empowerment and they investigated how ICTs can fight against gender violence in Africa. [Kibugu \(2019\)](#) collected data through group discussions and community planning sessions and found the positive impact of ICTs in agriculture and e-government in rural districts. [Nikpur \(2015\)](#) concluded that ICTs in developing countries and in male dominant societies empowered many women. Information and communication technology have lasting and transformative impact on women lives in India and Africa. [Nikpur \(2015\)](#) recognized the need of female engagement with the new technologies and they also found the ICTs a source in improving the gender relation which is more fruitful for economic growth and development.

[Ejaz \(2015\)](#) conducted an empirical analysis to determining the role of women in labour force in Pakistan it is empirical analysis of PSLM survey of Pakistan with respect to urban and rural areas specially. Logit and Probit models apply to determine the causes and effect on FLFP in Pakistan the results show that age, marital status, and educational attainment have positive and significant effect on female participation in the labour force.

[Afridi, Mukhopadhyay, and Sahoo \(2012\)](#) focused on many factors that affect the female work input in the labour market. By using cross-sectional data and logistic regression techniques researcher analysed that the female educational attainment level enhances the women work participation. [Riaz and Nadeem \(2019\)](#) has investigated the factors affect the low economic involvement of women as compare to men by using cross-sectional data of LFS 2008-09 and found ICTs as a main factor.

[Abrar ul haq, Jali, and Islam \(2019\)](#) investigated how ICTs empower women and progress women's status and their life quality. The study measured the division between the groups which have or have not accessed to ICTs and found low access of women to the internet and Mobile phones as a major factor of low participation of women in the social, economic and civil mainstream of their countries. [Nikulin \(2017\)](#) conducted a study by taking data of sixty developing countries and found that ICTs enable low-skilled workers to participate in the economy such as women and disable people.

According to [Naveed and Suhaib \(2019\)](#), the current age of ICTs allows women to work from home. The researchers claim that easy access to ICTs in all areas and awareness of women to fruits of ICTs has helped more women in Malaysia's labour force and empowered them.

[Efobi et al. \(2018\)](#) investigated how expansion in ICTs affects the economic role of females. The focus is Sub-Saharan countries of Africa during the period 1990-2014. The estimation techniques used to estimate data are an ordinary least square method, fix effects and generalized method of movements ([Li et al., 2020](#)). The result shows

improving ICTs enhance female economic participation. Therefore, based on the literature cited above, we can safely propose the following hypothesis.

H₁: = ICTs has a positive and significant impact on female economic participation.

Methodology and Data Source

The methodology section explains the strategy for estimation, a time series estimation approach to quantify the relationship among women labour force participation rate and information technology advancement in Pakistan for the period 1980-2016.

Table 1. Summary and Data Sources of Variables

Variables Explanation		Measures	Data Sources
FLFP	“it is our dependent variable which represents female economic participation.” It proxied as participation rate of female labour force.	Percentage to total Population	“World Development Indicators” (WDI)
Technology advancement	Two indicators used		
	Internet user “It represents internet users per 100 people.”	Mobile phone users “It represents number of mobile phone users per 100 people.”	Users per 100 people World Development Indicators (WDI)
Macroeconomic Variables	GDP (gross domestic product) “GDP is the final value of the good and services produced within the geographic boundaries of a country during a specified period, normally a year	FDI (foreign direct investment) “FDI is an investment in form of a controlling ownership in a business in one country by an entity based in another country”.	Trade liberalization “is the removal or reduction of restrictions on free exchange of goods between nations”.
		US\$	World Development Indicators (WDI)

Description of Variables

Female Economic Participation

The main dependent variable is women's economic participation. Female economic

participation refers to the female labour rate of participation. That means it measures the total active female population participating in economic activities. Which is measured as the female labour force participation rate. [Efobi et al. \(2018\)](#) to measure female economic participation that is a more appropriate way to identify an individual's involvement in economic activities.

Female economic participation is used as a proxy of the labour force rate defined by World Bank (2016), and this data is obtained from WDI.

Independent Variable (ICTs advancement)

Independent variable ICTs advancement is measured as two main indicators the "internet users per 100 people" and cellular phone users per 100 people. The internet users designate the number of persons who have access to a global network and the number of mobile phone users' number of individuals with access to cell phone technology. The main motive of using these two measures have two factors. First these are technologies that boost the labour stream by permitting their entry to the labour market by information. Falling social and cultural casts on the participation of females in economic activities through the availability of information and interaction with another world ([Cotten, Anderson, & McCullough, 2013](#)). These variables are important for technology advancement in developing countries ([Bertot, Jaeger, & Grimes, 2010](#)) WDI is the source of data for these variables.

Control Variables

For the interpretations of results and to the diminution of biases that caused by variable omission, the study uses control variables, trade liberalization (trade liberalization calculated as trade % to GDP), GDP and FDI. Female economic participation is influenced by chosen control variables across the country. Trade liberalization, GDP and FDI are anticipated as a significant and affirmative relation with the economic participation of women in developing countries ([Efobi et al., 2018](#); [Pieters, Strubbe, Capenberghs, & Vanhoe, 2012](#)) data obtained from WDI.

Data and Model

Baseline line model was taken from [Efobi et al. \(2018\)](#), ICTs are a function of women economic participation and other macroeconomic variables. They assessed the effect of ICTs advancement on women economic participation in South African counties. They derived this from [Signorelli, Choudhry, and Marelli \(2012\)](#), the model was expressed as

$$FLFPR_{it} = \text{crises}_{it} + \beta + z_{it} + \varepsilon_{it}$$

Signorelli measured financial crises impact on FLFPR ("female labour force participation rate") and to calculate the impact of ICT advancement on FLFPR model expressed as in ([Efobi et al., 2018](#)).

$$Y_{it} = \beta + \alpha T_{it} + \varphi X_{it} + \varepsilon_{it}$$

The current study used time series data analysis and concern is only one country Pakistan so cross responding equation is as

$$Y_t = \beta + \alpha \cdot T_t + \varphi \cdot X_t + \mu$$

$$FLFPR_t = \beta + \alpha \cdot ICT \text{ advancement}_t + \varphi \cdot macroeconomic_t + \mu$$

The dependent variable female economic participation, independent variables ICT Advancement and macro-economic variables expressed as Y, T and X respectively β is coefficient α and φ are estimators and μ is error term, time represented as t. There are two indicators of ICT advancement include mobile phone users, and internet users. The control variables also include per capita income, FDI and trade liberalization which is calculated trade % to GDP. Study used this model by little substantiation as study concern single country Pakistan.

Data is not stationary at a level so take 1st difference and apply Augmented Dicky fuller test to check unit root all variables are stationary at first defence. One optimum lag length is designated through VAR lag order selection criteria and chose SC criterion. When all variables are stationary at same order. Johansen co integration test, prominent cointegration test for 1(I) series are Engle–Granger cointegration test and Johansen cointegration test. Engle granger test deals with single equation model while Johansen deals with multiple equation models and here study deals with multiple equation models ([Hansen & Phillips, 1990](#); [Søren Johansen, 1995](#)).

Trace test and Max-eigenvalue tests confirmed co-integration among the series. The results show that there are at least 4 cointegrating equations at 5 percent level of significance when variables found co integrated we apply a vector error correction model to check long run and short run causality, it means to check the speed of adjustment to equilibrium in the long run and in short run.

Empirical Results

Summary Statistics

Summary statistics are specified in this section which depends upon dependent and independent variables; total observations are 26, mean, median, standard deviation, maximum and minimum values are discussed here. The results are represented in table 2.

Table 2. Descriptive Statistic Results

Measure by year	Mean	Median	Max	Min	SD
Female labour force participation rate	19.10700	17.94400	26.29400	12.86400	4.3514
Mobile phone users (per 100 people)	26.4830	2.479566	73.35733	0.00185	31.106
No of internet users (per 100 people)	5.242102	5.642102	16.12465	0.000123	5.2477
GDP per capita (constant us \$)	304.5703	336.2868	502.7867	100.300	115.41
FDI (net inflow of GDP)	1.41353	0.829203	3.668323	0.382827	0.8523
Trade liberalization (as % to GDP)	0.5683	0.000563	1.314648	0.0000	00.0001

Step 1

We have excluded a variable that was stationary at second difference, except that variable all variables are stationary at first at first difference.

Step 2

We applied Augmented Dickey-Fuller test statistic; all variables had a unit root at level. However, all variables are stationary at first difference. The findings are displayed below.

When ADF was applied at first difference.

Unit Root Test Results

Table 3. Result of unit root test results

Null Hypothesis: D(FDI_NET_INFLOW__OF_GDP) has a unit root		
Exogenous: Constant		
Lag Length: 0 (Automatic - based on SIC, maxlag=6)		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.370614	0.0217
Null Hypothesis: D(FLFP__OF_FEMALE_POPULATI) has a unit root		
Exogenous: Constant		
Lag Length: 0 (Automatic - based on SIC, maxlag=6)		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.072557	0.0004
Null Hypothesis: D(GDP_PER_CAPITA__CURRENT_) has a unit root		
Exogenous: Constant		
Lag Length: 0 (Automatic - based on SIC, maxlag=6)		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.480802	0.0016
Null Hypothesis: D(INTER_USER__POPULATION) has a unit root		
Exogenous: Constant		
Lag Length: 0 (Automatic - based on SIC, maxlag=6)		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.551293	0.0145
Null Hypothesis: D(MCS_PER_100_PEOPLE) has a unit root		
Exogenous: None		
Lag Length: 0 (Automatic - based on SIC, maxlag=6)		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.968123	0.0486
Null Hypothesis: D(TRADE_AS__TO_GDP) has a unit root		
Exogenous: Constant		
Lag Length: 0 (Automatic - based on SIC, maxlag=6)		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.035487	0.0047

Step 3

When all variables are stationary at the same order (i.e., stationary at the first difference in the current study), we can apply Johansen Cointegration Test.

Results Johansen Co Integration Test

Table 4. Results of trace test

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	Trace Statistic	Prob.**
None *	0.886896	161.0820	95.75366	0.0000
At most 1 *	0.753641	104.4163	69.81889	0.0436
At most 2 *	0.711144	67.99117	47.85613	0.0002
At most 3 *	0.561889	35.70363	29.79707	0.0093
At most 4	0.393897	14.24626	15.49471	0.0764
At most 5	0.046129	1.227904	3.841466	0.2678

Result shows that there are at least 4 co integration equations at 5% level of significance and there is cointegration among series.

Table 5. Results of max-Eigen test results

Hypothesized No. (s)	Eigenvalue	Max-Eigen Statistic	0.05Critical Value	Prob.**
Non	0.886896	56.66570	40.07757	0.0003
At most 1*	0.753641	36.42510	33.87687	0.0243
At most 2*	0.711144	32.28754	27.58434	0.0115
At most 3*	0.561889	21.45737	21.13162	0.0450
At most 4	0.393897	13.01835	14.26460	0.0779
At most 5	0.046129	1.227904	3.841466	0.2678

The results of the Max Eigen test show 5 equations at 5% level of significance and it confirms the cointegration among series.

Step 4

If there is cointegration among series, we use vector error correction model to check long-run and short-run causality first we check long-run causality by VECM.

Table 6. Vector error correction model results

S. No.	Coefficient	Std. Error	t-Statistic	Prob*
C1	-0.919433	0.344218	-2.671081	0.0174
C2	0.043095	0.021917	1.966299	0.0681
C3	0.204863	0.193348	1.059556	0.3061
C4	0.253918	0.43219401	0.587509	0.5656
C5	0.270331	0.272727	0.991214	0.3373
C6	0.003502	0.054121	0.064711	0.9493
C7	-0.855594	0.975320	-0.877245	0.3942
C8	-0.359734	0.938683	-0.383233	0.7069
C9	-0.003262	0.015733	-0.207327	0.8385
C10	126.6447	258.3116	0.490279	0.6310
C11	0.747108	0.312891	2.387759	0.0305

C (1) negative value of the first coefficient and its probe value less than 0.05 shows that significant and positive results show long-run causality among series.

Table 7. Granger Causality/ Short-Run Causality

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.919433	0.344218	-2.671081	0.0174
C(2)	0.043095	0.021917	1.966299	0.0681
C(3)	0.204863	0.193348	1.059556	0.3061
C(4)	0.253918	0.432194	0.587509	0.5656
C(5)	0.270331	0.272727	0.991214	0.3373
C(6)	0.003502	0.054121	0.064711	0.9493
C(7)	-0.855594	0.975320	-0.877245	0.3942
C(8)	-0.359734	0.938683	-0.383233	0.7069
C(9)	-0.003262	0.015733	-0.207327	0.8385
C(10)	126.6447	258.3116	0.490279	0.6310
C(11)	0.747108	0.312891	2.387759	0.0305
R-squared	0.872989	Mean dependent var		0.462385
Adjusted R-squared	0.254982	S.D. dependent var		0.775926
S.E. of regression	0.669736	Akaike info criterion		2.332241
Sum squared reside	6.728195	Schwarz criterion		2.864513
Log likelihood	-19.31914	Hannan-Quinn criter.		2.485516

Results and Discussions

The number of observations was 26 and unit root is applied to check stationarity ADF test is used to check unit root. All the variable is stationary at first difference. When all variables stationary at first difference then we applied the Johansen cointegration test to check cointegration among variables. Prominent cointegration tests for 1(I) series are the Engle-Granger cointegration test and the Johansen cointegration test. Engle granger test deals with single equation model while Johansen deals with multiple equation models and here study deals with multiple equation models.

The result of the trace test shows our 4 equations are at 5% level of significance. Eigen Max test result shows 5 equations at 5% level of significance it means cointegration does exist among variables and then apply VECM (vector correction error) model to check long run and short-run causality of variables. Results show negative value of first coefficient and prob is less than 0.05 show the series does have a long-run association. which means the speed of adjustment to the equilibrium in the long run. Granger causality test result shows the first value of the coefficient is positive and probability value is greater than 5%. We reject our null hypothesis that there is short-run causality in series. So, there is no short-run association among variables.

Our co-integration regression shows a long-run association among dependent variable female economic participation and independent variables information technology advancement indicators and other macroeconomic variables (FDI, CPI, and trade liberalization).

In table 2: the results of VECM show the negative value of the first coefficient and prob of at least one equation is greater than 0.05 shows there is a positive and significant relationship among variables in the long run. This infers that ICTs advancement in Pakistan has an auspicious effect on female economic participation.

Conclusion and Recommendations

Conclusions

The study has measured considering existing literature how spread in ICTs affects the contribution of a woman in Pakistan's economy. The analysis of the study carried out using time series data analysis. Data estimated after unit root testing by Augmented Dicky fuller test because all the variables are stationary at first difference Johansen cointegration test is used to check cointegration among series, Johansen cointegration test is named after Soren Johansen it is a technique for testing cointegration among multiple variable equation models first used by ([Søren Johansen, 1991](#)) the benefit of this procedure is that it is easy and therefore quite costless. VEC model to form long run and short association. The focus country is Pakistan for the period 1990-2018 study exposed ICT has a positive and significant impact on female economic participation in Pakistan.

By using mobile phones and the availability of the internet boosts the female economic involvement as they have more information, better job opportunities, have awareness about jobs and interact with another world. Being a developing country in Pakistan females feel secure at workplaces by having communication with their families, can care for their family and perform job tasks if they have better communication between family and workplace. Results show a positive and significant relationship. Trace test and Max-eigenvalue tests confirmed cointegration among the series. The Trace test results show at least 4 cointegration equations at a 5 percent level of significance. Max-eigenvalue test results show 5 equations are at a 5% level of significance.

The results demonstrate a positive relationship among variables. Female economic participation raises by inflow of internet and penetration mobile phone usage and ICT advancement in Pakistan. And the change in female economic involvement with advancement in ICT can be high as in developed countries after removing barriers like low access of women to ICTs, financial independence, cultural and moral barriers, and language barriers. As political consequences, Pakistan's government must develop and enforce policies that improve penetration of information and communication technology. Policy primacies should emphasize how to increase females' access to fast-speed internet and mobile phones. The future will have access to new policy mechanisms from which the exclusive benefits of ICT in women's economic participation can be increased.

Policy Recommendations

Based on findings, it is suggested that the government of Pakistan should make access to ICT easy for all women across the country whether in urban or rural areas. Government should provide greater financial independence to women, which can be

achieved by offering loans to poor and low-income women to establish small businesses and households and establish programs of awareness ICT. Government should make policies for the literacy of IT for women especially in rural areas.

Training programs for illiterate women should organize and government should focus on establishing some soft applications that are specially designed to operate for illiterate people. In Pakistan women economics participation is limited to some or few sectors like females are just limited to the teaching and medical sector. Hence government should make sure the women-friendly environment in institutions will encourage more women to work and to be part of the economic growth. Female economic participation should be encouraged by the government as well as the private sector by providing flexible working conditions which will, in turn, support more women to work.

Gender biasedness should be eliminated from the institutions and there should be strict checks on gender discrimination. The language of information technology should be convenient and familiar for all women. computer and mobile software application should be launched in a national language it is possible only with a corporation of government and IT companies this step must ripen the fruits of information technology advancement in the economic development of Pakistan especially in the context of female economic participation.

This research provides data and a gateway for further research in Pakistan.

Limitations and Forthcoming Research

Therefore, there is still a need for more research on the impact of information technology advancement on female sharing in economic activities in Pakistan being a developing country. Pakistan has many other factors which affect female economic participation with ICT advancement. Like ICT literacy and other moral and cultural norms which resist the access of women to ICT. And most women who work in informal sectors are a big part of our economy and most of them were illiterate and are unfamiliar with ICT advancements. Further research will cover the education factor along with information and communication technology advancement.

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