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Impact of ICT on women empowerment in South Asia

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ABSTRACT

Information and communication technologies (ICTs) have been increasingly promoted as a key solution for comprehensive development, poverty eradication and the empowerment of historically disadvantaged groups, such as women and minorities in the South Asia. ICT is a significant area of concern for women empowerment and growth of a country. This paper studied the status of ICT and women empowerment in South Asian countries. Based on empirical research this paper found that ICT has a positive impact on women empowerment.

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1.0 Introduction

This study is motivated by the potentially powerful role that information and communication technologies (ICTs) can play in the empowerment of women in South Asian countries. Many studies from different regions found that women empowerment and economic development are correlated. Studies also found that ICT ensured empowerment of women. South Asia is an overpopulated area. These nations comprise 21% (around 1.7 billion) of the world's total population of which 48% are women. And to ensure the development of this region women should be empowered. The objective of this study is to identify the status of ICT and its impact on women empower in South Asian countries.

ICTs are increasingly promoted as a key solution for comprehensive development, poverty eradication and the empowerment of historically disadvantaged groups, such as women and minorities in the South Asia (Bhatnagar & Schware, 2000; Friedman, 2005; Hafkin & Huyer, 2006; Hafkin & Taggert, 2001; Heeks, 2004, Uyer & Mitter, 2003; UNCTAD, 2002; International Telecommunication Union, 2002). An International Telecommunication Union (ITU) study (2002) describes ICTs as potentially powerful "development enablers" and the World Bank currently supports more than 1,000 projects with an IT component (The World Bank Gender Group, 2006).

As ICT and the economic development are correlated in south Asian countries (Islam & Mamun, 2013) hence it determines the ability of achieving competitive advantage at individual, organizational or government levels and enables them to do their job in more efficient and effective manner. Therefore, gender discrimination or unequal access to ICT may have serious implications for economic growth, human development, and the creation of wealth

(ITU, 2006). In fact at the World Summit on the information society, it was declared that the global challenge for the new millennium is to build a society where everyone can create, access, utilize and share information and knowledge; enabling individuals, communities and peoples to achieve their full potential in promoting sustainable development and improving their quality of life (WSIS, 2005).For this reason, research should be conducted here to identify whether ICT promoting women empowerment in south Asian countries. A literature review has been done to justify this work on this topic. Many studies have conducted on this topic in different parts of the word (Bhatnagar & Schware, 2000; Friedman, 2005; Hafkin & Huyer, 2006; Hafkin & Taggert, 2001; Heeks, 2004, Uyer & Mitter, 2003; Suresh, 2011; as well as in south Asia(Patil, et al. 2009). But this paper used different data sources and applied different methodology to get a real scenario about the impact of ICT on women empowerment in south Asian countries.

This paper is divided into the following sections; first it will highlight the importance of ICT, the concept of gender divide and the role of ICT in gender inequality. Then review of relevant literature to find the research gap, followed by the empirical study that is divided into the following sections: Data Sources, Data analysis, The Empirical Model and Methodology. Finally, the paper concluded with a policy implication.

2.0 Literature review

At the start of globalization after 1990 there has been a tremendous evolution and growth of information and Communication Technologies (ICT). Indeed ICT consolidated the growth and development of many multinationals corporations (MNCs) by efficiently handling the flow of information and establishing the control over distant subsidiaries (Laudon & Laudon, 2010). The developments in hardware, software, and electronics have led to affordable general purpose technologies (Bresnahan & Trajtenberg, 1995) that can be used in every space of life including the business and economics. ICT have been recognized as a major contributor in social and economic development (OECD, 2004). Numerous empirics including WEF (2009), Fontenay & Beltran (2008) suggest that ICT is also a means for economic development. This also highlights the importance of studying the role of ICT on empowering the women especially for developing economics.

2.01 ICT and development

ICTs are consistently hailed as one of the most effective tools for economic development. An ITU study (2005) describes ICTs as potentially powerful "development enablers:" they are cost-effective with significant transformative power, allow developing countries to leapfrog several stages of the development process and, in furnishing individuals directly with tools for self-empowerment, remove corrupt bureaucracies (Heeks, 2004; Karake-Shalhoub & Qasimi, 2007).In short, access to ICT and proper use of this access could place an economy on a higher income trajectory over time

2.02 Women empowerment and ICT

Women's empowerment is a complex, multidimensional concept, and needs to be defined and measured as a combination of related factors. In examining the intricate concept of women's empowerment, some measures that have been studied are the relationship between development and female labor force participation rate (FLFPR), also known as the U curve hypothesis, (Boserup 1970; Durand 1975; Goldin 1994; Galor & Weil 1996; Rau and Wazienski 1999;Mammen & Paxson 2000; Fuwa et al, 2006; Lincove, 2008), fertility (Galor & Weil 1996; Angeles et al. 2005), educational attainment (Lincove 2008; Nuss & Majka 1985; Goldin 1994) , decision making ability (Amin & Lloyd 2002; Fletschner 2008), and the population sex ratio. (Sen 1992)

The literature on the enormous opportunities ICTs can provide for women's empowerment is vibrant and wide ranging. Kelkar and Nathan (2002, p. 433) have argued that ITs have the potential to "redefine traditional gender roles" and that "the spread of IT-enabled services has been immensely beneficial to both women and men, especially those who have limited skills or lack of resources to invest in higher education." Drucker (2001) has called ICTs the "great equalizer" and pioneers in the field of gender empowerment through ICTs, both in academe and advocacy, such as Hafkin & Taggert (2001), Huyer (2002), Mitter (2003), Nath (2001), Sharma (2003), Sharma (2004) have convincingly shown that access to and effective use of ICTs contributes to women's empowerment and capacity building in numerous ways.

So, women's empowerment and a country's level of economic development are inextricably linked (Boserup 1970; Elson, 1995; Parpart & Marchand, 1995; Nussbaum, 2001; Sen, 2000). For instance, UN Secretary-General Koª Annan (2005) has called the empowerment of women "the most effective development tool." Sharma (2003) argues that "societies that discriminate by gender pay a high price in terms of their ability to develop and to reduce poverty" (p. 1), an assertion that has been supported by every annual United Nations Human Development Report since 2001 (UNDP, 2001).

Despite these great promises and numerous success stories, one must not be seduced into believing that ICT-enabled development projects for women are panaceas, but be mindful of the very significant challenges faced by women in ICT-based businesses. Indeed, the IT sector remains one of the most gendered sectors (Archibald, et al., 2005; Mitter & Rowbotham, 1997; Patel & Parmentier, 2005). Ubiquitously, women face barriers to the use of ICTs, mostly lack of training, lack of access, the high costs of equipment and connection as well as software and hardware applications and designs that do not reject the needs of women (Hafkin & Huyer, 2006; Hafkin & Taggert 2001; Mies & Shiva, 1993; Mitter, 2003; Mitter & Sen 2000; Sciadas, 2005).

These barriers are often exacerbated by extreme poverty and highly patriarchal social structures that relegate women to a much inferior status. Hafkin (2000) has also shown that gender discrimination is often transferred, presumably unintentionally, because ICTs are designed by "Western men who do not understand the social, economic, or cultural contexts for use of these technologies" (p. 4).

3.0 Data and the methodology

This study uses digital divide variable for ICT. Using the principal component analysis, variables like cell subscriber (%), fixed broadband (%), internet server per million, internet user (%), and telephone line user (%) are converted into linearly uncorrelated variable called 'digital divide'(Islam & Mamun, 2013). For women empowerment three different variables have been used like Female enrollment to total enrollment in primary (%),Female enrollment to total enrollment in secondary (%), and Female labor to total labor(%). All the dada have been collected from World Bank between the years 1995 to 2013.

Regarding the methodology the current study has initially employed descriptive statistics to understand the nature of women empowerment among south Asian countries. Upon investigating the impact of digital divide on women empowerment amongst the countries, the study has used various panel methodologies to answer the question whether the use of ICT impact women empowerment in south Asian countries. Thus the research question that has been addressed in this study is, whether the use of ICT can ensure women empowerment in south Asian countries, if yeas, does it have any economic impact. To address the second question initially panel unit root tests proposed by Levin et al. (2002) have been used to understanding the nature of data set. Upon understanding the characteristics of the data set, the study has avoided the vector error correction based on Johansson cointegration test in favor of static and dynamic panel models.

The conventional panel techniques are widely used in growth literature[1] to capture the steady-state relationship between the dependent and independent variables. These are based on fixed effect estimator to explore the relationship between ICT related variables and women empowerment within each country. This estimator has common slopes and variance and specific intercept. The rationale behind using this estimator is to control for all possible unobserved characteristics of each country in the study. The basic model for panel data study has been presented in the following equation (01):

$$\text{Women Empowerment}_{it} = \beta_0 + \beta' \text{ICT}_{it} + \mu_{it} \quad \text{...}(01)$$

Women Empowerment it is the dependent variable (proxied by Female enrollment to total enrollment in primary (%), Female enrollment to total enrollment in secondary (%), and Female labor to total labor(%)) observed in i^{th} country and *t* represents time periods. Moreover, ICT_{it} represents the variables measuring the digital divide and β is the coefficient of these variables, while μ_{it} is the error term.

3.01 Panel fixed and random effect model

The fixed effects model has constant slopes but intercepts differ according to the cross-sectional units. For *i* countries *i*–1 dummy variables are used to designate the particular country. Another fixed effects panel model where the slope coefficients are constant, but the intercept varies over individual/ country as well as time. Fixed effect model with differential intercepts and slopes can also be used however; inclusion of lot of variables and dummies may give inconclusive result since so many dummies may result the problem of multicollinarity. There is also a fixed effects panel model in which both intercepts and slopes might vary according to country and time. This model specifies i-1 country dummies, t-1 time dummies, the variables under consideration and the interactions between them.

[1] For example, see Barro and Sala-i-Martin (1992) and Mankiew et al. (1992).

In the random effects model the intercept is assumed to be a random outcome variable, whereas the random outcome is a function of a mean value plus a random error. Two way random effects model is used for estimation purpose. Swamy and Arora (1972) suggested the random effects model and Swamy and Arora (1972) and Swamy et al. (1988a, 1989) suggested an extension of the random effects model as follows:

$$y_{it} = B_i' x_{it} + \varepsilon_{it}, \qquad t = 1,\ldots\ldots T(i), i = 1,\ldots\ldots N \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(02)$$
$$\beta_i = \beta + \nu_i. \quad where\ E[\nu] = 0\ and\ Var[\nu_i] = \Omega$$

This model is a generalized, Group-wise heteroscedastic model. Moreover, for selecting the best model there are different test like F test, Hausman Specification Test, Breusch-Pagan Lagrange Multiplier test, which have been applied to decide the best fitting model.

3.02 The panel ARDL approaches

As the study aims at identifying the long-run and association between ICT variables and women empowerment as well as their short term impact, the appropriate technique to be followed is autoregressive distributed lag ARDL (p, q) model by Pesaran and Smith (1995) following maximum likelihood (MLE) based estimation. There are three different approaches of panel ARDL proposed by Pesaran and Smith (1995) i.e. the mean group (MG), the pooled mean group (PMG) and the dynamic fixed effect (DFE). The study has used all the three approaches.

The first form of panel ARDL is known as mean group (MG) introduced by Pesaran and Smith (1995). This model estimates the long run parameters for the panel from an average of the long run coefficients from ARDL models for each cross sectional units. Thus in a panel set up of the like the following:

$$\text{Y}_{it} = \alpha_i + \gamma_i Y_{i,t-1} + \beta_i X_{it} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots(03)$$

The long run parameter θ_i for country 'i' is $\theta_i = \beta_i / 1 - \gamma_i$ while MG estimator for panel is $\hat{\theta}_i = \frac{1}{N}\sum_{i=1}^{N}\theta_i$ an $\hat{a}_i = \frac{1}{N}\sum_{i=1}^{N} a_i$.

Thus it is clear that this model estimates separate regressions for each countries and then calculate parameters as unweighted means of the estimated coefficients for the individual countries without imposing any restriction; so all coefficients are allowed to be heterogeneous in the long-run and in the short-run. However, the necessary condition for the consistency and validity of this approach is to have a sufficiently large time-series dimension. Moreover the cross-country dimension should also be large (about 20 to 30 units according to Pesaran et al. (1999) at I (0) or I (I) order integration. With short time series data this model however may give misleading result.

Though Johansen (1995), Philipps & Hansen (1990) argue that a long-run relationships exist only in the context of cointegration among integrated variables, but Pesaran and Smith (1995) counter such assumptions by presenting MG and PMG with better efficiency. The application of PMG and even MG estimators do not require cointegration tests. Since the mixed integrated order amongst the variables do not affect the efficiency of the estimation hence conventional stationarity check is no longer required. Moreover, this model is appropriate for the panel with large N and T dimensions thus there is no issue of short panel or long panel in the estimation.

PMG also allows short-run coefficients including the intercepts and the speed of adjustment to the long run equilibrium to be heterogeneous country by country, while the long-run slope coefficients are restricted to be homogeneous across countries. Thus this study chooses PMG model suggested by Pesaran and Smith (1995) in the following format:

$$y_{it} = \mu_i + \sum_{j=1}^{p} \lambda_{ij} y_{it-j} + \sum_{j=0}^{q} \delta_{ij}^{/} \chi_{it-j} + \varepsilon_{it} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(04)$$

Where, i = 1, 2,....., N represents cross sectional unit t = 1, 2, 3, ...T represent time (annual), j is the number of time lag, y_{it} = $GDPPC_{it}$, x_{it} = independent variables like telephone line $users_{it}$, internet $users_{it}$, cell phone $subscribers_{it}$ etc. and finally μ_i is the fixed effect. By re-parameterization, the above equation can be written as:

$$\Delta y_{it} = \mu_i + \phi_i y_{it-1} + \beta_i' \chi_{it} + \sum_{j=1}^{p-1} \lambda_{ij^*} \Delta y_{it-j} + \sum_{j=0}^{q-1} \delta_{ij}'^{*} \Delta \chi_{it-j} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(05)$$

Where, $\phi_i = -1(1-\sum_{j=1}^{p}\lambda_{ij}),\ \beta_i = \sum_{j=0}^{p}\delta_{ij},$

$$\lambda_{ij^*} = -\sum_{m=j+1}^{p}\lambda_{im},\ j = 1,2,,\ldots\ldots,\ p-1,\ and$$

$$\delta_{ij^*} = -\sum_{m=j+1}^{p}\delta_{im},\ j = 1,2,,\ldots\ldots,\ q-1.$$

Now by grouping the variables in levels further, Eq. (5) is rewritten as an error correction equation:

$$\Delta y_{it} = \mu_i + \phi_i(y_{it-1} - \theta_i'\chi_{it}) + \sum_{j=1}^{p-1}\lambda_{ij^*}\Delta y_{it-j} + \sum_{j=0}^{q-1}\delta_{ij}^{*'}\Delta\chi_{it-j} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots(06)$$

Where $\theta_i=-(\beta_i/\phi_i)$ defines the long-run or equilibrium relationship among y_{it} and x_{it}. In contrast λ_{ij^*} and $\delta_{ij}^{*'}$ are short run coefficients relating growth to its past values and other determinants like x_{it}. Finally, the error-correction coefficient ϕ_i measures the speed of adjustment of y_{it} toward its long-run equilibrium following a change in x_{it}. The condition $\phi_i<0$ ensures that a long-run relationship exists. Therefore, a significant and negative value of ϕ_i is treated as an evidence of co integration between y_{it} and x_{it}.

4.0 Analysis and findings

Table 01 represents descriptive statistics of this study. Variables taken of eight countries and from 1995 to 2013 time series data that constitute 152 numbers. Here N stand for the total number of the values. There is no missing values in this table. Mean represent the mean value of the variables. Min, max and St.dev stand for minimum value, maximum value and standard deviation respectively. We can find the median value from this table as well. This table also shows 25% and 75% coverage of the variables.

Table 01: Descriptive statistics

Variables	N	mean	min	max	St. dev	25%	Median	75%
Digital divide	152	0.000	-1.169	8.613	1.700	-1.020	-0.578	0.266
Female enrollment to total enrollment in primary education(FE in PE)	152	0.465	0.076	0.590	0.061	0.443	0.492	0.501
Female enrollment to total enrollment in secondary education(FE in SE)	152	0.451	0.168	0.568	0.080	0.419	0.470	0.513
Female labor to total labor(FLTL)	152	32.033	12.223	50.810	11.103	23.573	33.340	40.122
Trade Openness (TO)	152	67.116	1.250	223.064	46.257	35.662	48.670	81.396
Fixed capital formation(FCF)	152	20.928	16.836	26.039	2.403	18.850	20.835	22.571
Labor force(LF)	152	15.942	11.125	19.998	2.604	14.079	16.060	17.877
GDP growth(GDPG)	152	6.109	-8.675	21.021	3.474	4.474	5.947	7.463

Table 01 represents descriptive statistics of this study. Variables taken of eight countries and from 1995 to 2013 time series data that constitute 152 numbers. Here N stand for the total number of the values. There is no missing values in this table. Mean represent the mean value of the variables. Min, max and sd stand for minimum value, maximum value and standard deviation respectively. We can find the median value from this table as well. This table also shows 25% and 75% coverage of the variables.

Table 02: Correlation matrix

Variables		1	23	4	5	6	7	8
FE in PE	1	0.1066*						
FE in SE	2	0.1764**	0.8592					
FLTL	3	0.0228*	0.6256	0.6128				
Trade openness	4	-0.0505	0.2066	0.3232	0.2569			
Fixed capital formation	5	0.1152	0.1930	0.0831	-0.2822	-0.5285		
Labour force	6	0.0678	-0.0111	-0.1640	-0.2695	-0.7631	0.8981	
GDPG	7	-0.1224	-0.0620	-0.0840	-0.0926	0.1196	-0.1002	-0.1549

Table 02 shows the status of correlation matrix. Three variables like female enrolment to total enrolment in primary education, female enrolment to total enrolment in secondary education and female enrolment to total labour force are correlated with digital divide. Where female enrolment to total enrolment in secondary education is significantly correlated. So correlation matrix justify the rationality of this methodology to identify the impact of digital divide on women empowerment.

However, before moving to the panel regression, the level of integration has been determined by panel unit root test suggested by Dickey and Fuller (1979) and others. The result summarized in table 03.

Table 03: Result from panel unit root test (with individual intercept and no trend under first difference)

Variables	Assumes common unit root process	Assumes individual unit root process		
	Levin, Lin & Chu t*	Im, Pesaran and Shin W-stat	ADF - Fisher Chi-square	PP - Fisher Chi-square
GDP Per capita	-3.721**	-3.457**	38.435**	65.174***
Telephone line user (%)	-2.811**	-2.351**	30.345**	57.741***
Internet user (%)	1.891	2.752	7.231	15.972
Fixed broadband (%)	2.862	2.928	13.016	17.058
Fixed capital formation	-3.281**	-3.628**	32.254**	28.261**
Labour force	-3.748**	-3.121**	36.231**	23.124**
Trade Openness	-4.861**	-5.231**	12.325**	6.123**
Digital divide	-2.461**	-2.261**	6.362**	6.124**
Primary education	-3.662**	-3.262**	6.126**	6.112**

***, **, * refers significance at 1%, 5% and 19% respectively

The result from panel unit root test suggests that not all the variables of interest are integrated at same order. This result suggests that the application of Johansen cointegration, Engle ganger or VECM based cointegration test will not be applicable in this data set. Though cross sectional units are not that large yet the study has applied panel static models like OLS, fixed effect and random effect model as well as panel ARDL models like MG, PMG and DFE estimates suggested by Pesaran et al. (1999).

Using the equation of 1 and 2 the fixed effect and random effect model has been estimated as:

$$Women\ Empowerment_{it} = \alpha_i + \zeta_1 Digital\ Divide_{it} + \zeta_2 Labor\ Force + \zeta_3 Trade\ Openness_{it} + \zeta_4 Fixed\ Capital\ Formation_{it} + \delta_{it} \quad \text{.......} (08)$$

$$Women\ Empowerment_{it} = \alpha_i + \zeta_1 Digital\ Divide_{it} + \zeta_2 Labor\ Force_{it} + \zeta_3 Trade\ Openness_{it} + \zeta_4 Fixed\ Capital\ Formation_{it} + \nu_{it} + \delta_{it} \quad \text{.......} (09)$$

Moreover, following the (Pesaran and Smith (1995); Pesaran et al. (1999)) methodology for MG, PMG, and DFE models as presented in equation 06, the following equation has been developed.

$$\Delta \text{Women Empowerment}_{it} = -\mu_i + \phi_i (Women\ Empowerment_{i,t-1} - \lambda_1 Labor\ Force_{i,t-1} - \lambda_2 GDP_{i,t-1} - \lambda_3 Trade\ Openness_{i,t-1} - \lambda_4 Fixed\ Capital\ Formation_{i,t-1}) + \sum_{j=1}^{p-1} \gamma_j^i \Delta (Women\ Empowerment_i)_{t-j} + \sum_{j=0}^{q-1} \delta_{1j}^{i} \Delta Digital\ divide_{i,t-j} + \sum_{j=0}^{q-1} \delta_{2j}^{i} \Delta Labor\ Force_{i,t-j} + \sum_{j=0}^{q-1} \delta_{3j}^{i} \Delta Trade\ Openness_{i,t-j} + \sum_{j=0}^{q-1} \delta_{4j}^{i} \Delta fixed\ Capital\ Formation_{i,t-j} + \varepsilon_{i,t} \quad \text{.......} (10)$$

Table 03 and table 04 present the result of the static and dynamic models. In order to test the validity of the impact of ICT on women empowerment first this study used a less efficient regression model such as OLS, fixed effect and random effect model following equation 8, 9 and 10.

The result from the panel OLS with no consideration of the panel structure suggests that digital divide has positive and significant long term impact on the women empowerment in South Asian countries. Though the study did not find any significant impact of ICT on empowerment at primary education level but at secondary level it revealed that there is an impact. In terms of female labor participation table shows a significant progress in this area that enhanced the women empowerment too.

Table 04: Panel static models

Variables	Female labour participation			Primary education			Secondary education		
	FE	RE	PA	FE	RE	PA	FE	RE	PA
DigDiv	0.035 c	0.041 c	0.035 c	0.001	0.001	0.000	0.021 c	0.021 c	0.023 c
	(1.68)	(1.87)	(1.75)	(0.07)	(0.03)	(0.01)	(1.92)	(1.82)	(1.84)
TO	-0.016 a	-0.013 c	-0.0154 a	-0.000	-0.000	-0.000	-0.003 a	-0.003 a	-0.003 a
	(-3.36)	(-2.33)	(-3.33)	(-0.38)	(-0.19)	(-0.14)	(-4.33)	(-3.81)	(-3.88)
FCF	-1.39 a	-0.974 a	-1.338 a	0.028 a	0.031a	0.031 a	0.024 a	0.029 a	0.029 a
	(-6.54)	(-4.02)	(-6.41)	(5.30)	(7.61)	(8.08)	(6.69)	(9.34)	(9.48)
LF	17.126 a	14.566 a	16.809 a	-0.004	-0.022 c	-0.024 b	0.027	-0.006	-0.006
	(18.51)	(14.29)	(18.57)	(-0.15)	(-2.06)	(-3.09)	(1.76)	(-0.55)	(-0.54)
α	-210.86 a	-178.94 a	-206.92 a	-0.064	0.169	0.200 c	-0.472 c	-0.050	-0.053
	(-18.40)	(-12.67)	(-10.55)	(-0.22)	(1.27)	(2.10)	(-2.42)	(-0.35)	(-0.37)
R^2	0.7950	0.621	0.642	0.361	.321	.382	0.569	.583	.584
N	152	152	152	152	152	152	152	152	152

In addition to digital divide this model also used fixed capital formation, trade openness and trade openness to have a comprehensive idea about this area. Trade openness has a long term negative relationship in all areas of women empowerment. Regarding fixed capital formation the table shows there is a significant negative long term relationship with the women empowerment at labor participation but has positive relationship in other areas of women empowerment. However, looking at the outcome of the fixed effect model digital divide shows a long term positive impact on women empowerment of the south Asian countries. Furthermore the calculated r^2, which measures variance due to the difference across the panel data, are 0.795, 0.3611 and 0.5698. Since the r^2 values are high, thus the study concludes that there is a cross sectional or unique country effect on empowerment. The country dummies of the OLS clearly prove this point.

Finally the random effect model also generates the same result consistent with the OLS and FE model. However, this model shows additional information i.e. Cross-section random of 0.426 and Idiosyncratic random of 0.124 respectively while the rho is o.9208. This means that 46.19% variation is due to the cross sectional effect while 13.46% variation is due to time differences.

Furthermore the Breusch and Pagan Lagrangian multiplier test for random effects generates a $\chi^2(1) =$ 452.12 with Prob> $\chi^2(1) =$ 0.0000. Thus the test result firmly rejects the null and concludes that random effects are not appropriate. Thus there is evidence of significant differences across countries. Therefore running a simple OLS regression will not suffix. However, in choosing between FE and RE model, the application of Hausman test fails to make a significant difference between them.

After analyzing the effectiveness of fixed and random effect model in explaining the GDP per capita, dynamic panel models have also been used. The following table 04 reports MG, PMG and DFE estimates and specification tests of equation (10). The result indicates that the error-correction coefficient ϕ_i is negative and significant and fall within the dynamically stable range for MG model. However this is not the case for PMG and DFE estimators. This indicates that there exists a long-run relationship between GDP per capita and the ICT related factors. Moreover, this also gives evidences of mean reversion to a non-spurious long-run relationship and therefore stationary residuals, meaning that GDP per capita and ICT variables are cointegrated. Moreover, a higher average λ_i's imply greater adjustment process towards the long run equilibrium GDP per capita. Before moving further into the discussion, it is important to note that not all the variables used in OLS, FE, RE has been used in the dynamic estimations. This is because use of such variables does not generate a result. Moreover, the presence of negative but statistically insignificant error correction in the PMG and DFE method confines the choice to MG model only. This is also evident in the Hausman test result.

Table 05: Panel dynamic models

	Primary education		Secondary education		Labour Force	
	MG	PMG	MG	PMG	MG	PMG
Long run						
DigDiv	0.0132	0.0070**	-0.0002	0.0027*	0.0950*	0.1476*
	(0.79)	(3.08)	(-0.04)	(1.78)	(1.66)	(2.50)
TO	0.0018	0.0005**	-0.0000	0.0002*	0.0880	-0.0052**
	(1.91)	(2.75)	(-0.06)	(2.53)	(1.12)	(-2.72)
FCF	-0.0157	0.0431***	0.0105	0.0654***	-1.1031	-0.2370
	(-0.34)	(11.54)	(0.80)	(5.15)	(-1.09)	(-1.37)

LF	0.3124	-0.0876***	0.2294*	-0.0911***	13.8971*	8.2162***
	(1.10)	(-7.80)	(2.51)	(-3.55)	(2.29)	(9.11)
GDP_Growth	-0.0079	-0.0014	-0.0032	-0.0016***	-0.4176	0.1324***
	(-1.15)	(-1.82)	(-1.56)	(-4.57)	(-1.08)	(4.47)
Short run						
EC	-0.7182***	-0.2729***	-0.8606***	-0.2721	-0.2380	-0.2779**
	(-5.51)	(-3.82)	(-5.50)	(-1.94)	(-1.52)	(-2.60)
ΔDigDiv	-0.0225	-0.0242	-0.0020	-0.0016	-0.0325	0.0783*
	(-1.33)	(-0.89)	(-0.70)	(-1.02)	(-0.53)	(2.38)
ΔTO	-0.0002	0.0004	0.0006	0.0000	0.0054	0.0000
	(-0.52)	(1.38)	(1.32)	(0.12)	(0.84)	(0.01)
ΔFCF	0.0303	-0.0176	0.0044	-0.0194**	-0.1170	-0.3488
	(0.74)	(-1.41)	(0.30)	(-2.78)	(-0.18)	(-0.76)
ΔLF	-0.1078	0.1135	-0.0147	0.1140	8.5396	13.6726*
	(-0.22)	(0.73)	(-0.07)	(0.65)	(1.12)	(2.20)
ΔGDP_Growth	0.0005	-0.0034	0.0004	-0.0002	0.0043	-0.0276
	(0.67)	(-0.93)	(0.92)	(-0.39)	(0.12)	(-1.86)
α	-5.2213	0.2564***	-2.8522*	0.1212**	-57.5335	-24.2902*
	(-1.08)	(3.58)	(-2.10)	(2.87)	(-1.24)	(-2.48)
Hausman Test	2.36		2.24		3.36 (0.186)	
	(0.126)		(0.114)			
N	144	144	144	144	144	144

Thus the study only focuses on the result from MG model in discovering the potential dynamic effect of the ICT variables on economic growth in SAARC countries. The error correction coefficient suggest that under MG model the speed of adjustment is quite slow i.e. it takes around 10 years to adjust any deviation in the long run path determined by the relationship between ICT variables and economic growth. Regarding the long-run coefficient, consistent with the static models, internet use has been found to have significant long term impact on the economic growth in SAARC countries while cell phone subscriber has been found to have very insignificant negative long run relationship with GDP per capita. However such finding is statistically insignificant as well. The long run coefficient of internet use of 0.181 suggests that a 1% change increase in the internet use in the SAARC countries can lead to 0.181% increase in the GDP per capita in the region. This is really a phenomenal finding and thus a reduction of digital divide will surely yield more economic growth for the SAARC countries. However, as opposed to the significant long run relationship, the short run relationship between internet use and GDP per capita has been found to negative but statistically insignificant.

5.0 Conclusion

The objective of this paper was to find the possible impact of ICT on women empowerment. This study used regression analysis to identify this impact. Study revealed that ICT has a positive impact on the women empowerment. Since women empowerment and economic development are closely related (Duflo 2012) we should be concern about enhancing empowerment of women. Therefore to enhance the women empowerment focus should be given to the development of ICT.

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Appendix

Table 01: Descriptive statistics of different ICT indicators of SAARC countries (1995-2011)

Countries	Variables	Mean	Std. Dev.	Jarque-Bera	Probability
Bangladesh	Cell subscriber (%)	12.78	18.63	4.09	0.13
	Fixed broadband (%)	0.01	0.02	3.33	0.19
	Internet server per million	0.08	0.17	38.91	0.00
	Internet user (%)	1.06	1.58	5.15	0.08
	Telephone line user (%)	0.61	0.30	1.68	0.43
Afghanistan	Cell subscriber (%)	11.11	17.32	5.61	0.06
	Fixed broadband (%)	0.00	0.00	8.42	0.01
	Internet server per million	0.12	0.20	10.81	0.00
	Internet user (%)	1.07	1.51	3.64	0.16
	Telephone line user (%)	0.17	0.10	1.47	0.48
India	Cell subscriber (%)	15.20	23.00	6.59	0.04
	Fixed broadband (%)	0.21	0.34	6.26	0.04
	Internet server per million	0.64	0.85	6.14	0.05
	Internet user (%)	2.54	2.88	5.55	0.06
	Telephone line user (%)	2.98	0.91	0.89	0.64
Pakistan	Cell subscriber (%)	17.73	24.41	2.93	0.23
	Fixed broadband (%)	0.06	0.12	16.51	0.00
	Internet server per million	0.28	0.35	3.73	0.16
	Internet user (%)	3.91	3.46	2.05	0.36
	Telephone line user (%)	2.59	0.64	1.37	0.50
Maldives	Cell subscriber (%)	56.60	63.77	2.21	0.33
	Fixed broadband (%)	1.66	2.28	2.86	0.24
	Internet server per million	14.86	24.50	10.32	0.01
	Internet user (%)	10.03	11.08	2.77	0.25
	Telephone line user (%)	9.33	2.31	1.34	0.51
Bhutan	Cell subscriber (%)	11.29	18.49	5.48	0.06
	Fixed broadband (%)	0.12	0.31	53.34	0.00
	Internet server per million	0.52	1.42	20.31	0.00
	Internet user (%)	3.14	3.75	7.17	0.03
	Telephone line user (%)	3.12	1.32	1.14	0.57
Sri Lanka	Cell subscriber (%)	24.67	31.72	3.35	0.19
	Fixed broadband (%)	0.28	0.49	14.29	0.00
	Internet server per million	1.61	1.82	2.88	0.24
	Internet user (%)	3.33	4.56	7.78	0.02
	Telephone line user (%)	7.69	6.06	2.28	0.32
Nepal	Cell subscriber (%)	19.66	33.13	335.74	0.00
	Fixed broadband (%)	0.30	0.98	2757.03	0.00
	Internet server per million	2.33	9.77	10957.95	0.00
	Internet user (%)	3.33	5.49	935.04	0.00
	Telephone line user (%)	3.52	3.88	133.50	0.00