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Effect of ICT and E-Government on Public Revenue: Evidence from South Asian Economies

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Abstract
The growing importance of information and communication technologies (ICTs) and e-government has attracted the attention of researchers dedicated to enhancing public revenue. The present study aims to conduct an empirical analysis to investigate the influence of information and communication technology (ICT) and e-government on the public revenue of economies in South Asia. The panel of eight South Asian economies was constructed using data from 2001 to 2021. The empirical examination used econometric estimation techniques such as pooled regression, fixed effect model, and Generalised Least Square (GLS). The findings of the regression model indicate that there is a positive relationship between ICT and its corresponding indices with public revenue. The impact of fixed broadband subscription is notably more significant compared to other indices of ICT. Furthermore, it is worth noting that the influence of e-government in South Asia has been observed to affect public revenue positively. The study's findings' implications are significant in elevating public revenue in the South Asian region.
Keywords: ICT, E-government, Public revenue, Internet users, South Asia

1. Introduction

The significance of public revenue arises due to allocating a significant chunk of the public revenue towards providing healthcare, education, welfare schemes, and defence services. In addition, public revenue is also used to meet the interest payments the government makes to its lenders. Internationally, countries increasingly recognise the importance of a well-operating revenue system in driving economic growth. One of the main focuses of policymakers in recent decades has been understanding the various factors that impact revenue potential, specifically concerning the revenue-to-GDP ratio. Many developing nations face challenges in generating sufficient funds for government expenditures. Insufficient investments in crucial infrastructure and human resources have hindered long-term economic growth and development in certain countries due to budget deficits and inefficient use of public funds. Countries must primarily depend on their sources of income to ensure the long-term sustainability of their debt, as excessive reliance on foreign funding can lead to potential issues (Javid & Arif, 2012). The primary objective for national governments and international institutions is to mobilise financial resources, including public funds, to support development, particularly the Sustainable Development Goals (SDGs) outlined in the Agenda 2030 (Shair et al., 2024). Public funding is widely acknowledged as vital in pursuing the SDGs outlined in Agenda 2030. Information and communications technology (ICT), specifically internet connectivity, is critical for implementing SDG-focused initiatives. ICT use and adoption rapidly expand globally (Shair et al., 2023).

ICT is currently driving significant improvements in the general quality of service delivery. In terms of public sector performance, they are also widely seen as a solution to various problems prohibiting governments from offering their citizens effective services. This is particularly true in public revenue and tax revenue collection, where government organisations regularly face issues with relationships and trust that make it challenging to strengthen cooperative operations and provide services to citizens. In these situations, the government has been hailed as a way to save expenses while enhancing service quality, rapidity, and accessibility. Additionally, policymakers in advanced economies have acknowledged ICT adoption by the public sector (e-government) to enhance public administration's effectiveness and efficiency, lower corruption, and raise transparency (Nisar, 2006).

However, it is also widely agreed that, both directly and indirectly, the use of ICT may favour public finances. On the one hand, technology increases the efficiency of tax authorities by, among other things, enabling more effective software, computerised income tax filing, and improved maintenance of records. This increases taxpayer compliance and more efficient revenue collection (Njoh, 2018). According to Adam and Alhassan (2021), technology is a significant force behind innovation and economic expansion. This position may help the government's ability to raise money indirectly. Worldwide use of ICT has opened up new opportunities for established and emerging economies to pursue revenue generation and economic growth.

The practice of leveraging ICT by government institutions in interactions between governments and individuals, corporations, and local government activities to streamline and enhance governance is "e-government" (Backus, 2001). This practice reduced bribery, more accurate transparency, more ease of use, increased revenue, and reduced expenses are some benefits of this initiative. According to (Njoh, 2018), governments made this substantial investment in ICT to increase the effectiveness of public services. This increase in efficiency eventually reduces tax evasion. It increases government revenue due to upgraded tax filing and electronic payment systems, which limit the scope of tax escape and decrease bribery (Adam, 2020).

Given the backdrop of the emerging importance of ICT diffusion and e-government in increasing public revenue. It is imperative to examine the public revenue nexus with the indicators of ICT for the South Asia region. The importance of the South Asia region emerges as it is a place of one-fourth of the global population. The public revenue as a percentage of GDP remains stagnant in the range of 10 to 15 per cent in South Asia, which is lower than the level of OECD and Europe & Central Asian economies, which surpass 35 per cent of GDP (see Figure 1). The differences in the level of revenue can be attributed to higher growth of GDP per capita, FDI, government stability, rule of law, and trade, among others. It is also evident from the literature that the rate of ICT was also high in these countries after 1995, which is another factor contributing to this difference in revenue. 8 of the top 10 countries in the world for e-commerce earnings are OECD members (Casella et al., 2019).

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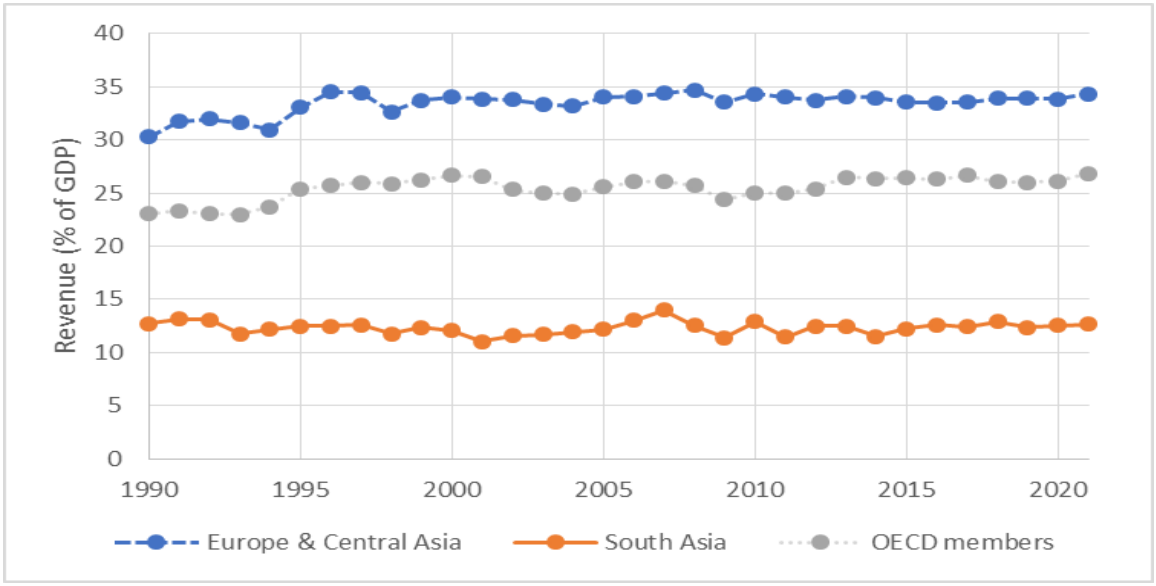


Figure 1: Revenue as a percentage of GDP across the regions

The economic consequences of ICT have been extensively examined in the literature (Rahman et al., 2021; Mahyideen et al., 2012; Latif et al., 2017; Majeed & Malik, 2016; Shair et al., 2022a; Shair et al., 2022b). In the literature on the impact of ICT, a study by Shim and Eom (2009) analysed the role of ICT in reducing corruption. In the same way, Holt and Jamison (2009) demonstrate that broadband expansion is advantageous for economic growth. Salatin and Fallah (2014) provided a comprehensive study in middle- and high-income countries and found that ICT considerably enhanced governance quality. Similarly, spreading information, reducing costs, and having more internet subscribers positively affected economic growth (Choi & Yi, 2009; Zanden, 2023).

The link between e-government and economic growth is exposed as it promotes the spread of knowledge and makes it possible for economies to reach their maximum potential. The existing literature showed that e-government significantly and favourably affected corruption (Audi et al., 2021; Ali et al., 2021; Audi et al., 2022; Alam et al., 2023). Castro and Lopes (2022) prove that e-government increases the likelihood of achieving sustainable development, primarily in developing and transitional countries. E-government, or the use of ICT in the public sector, influences economic development, as Khan and Majeed (2020) noted. Research conducted by Adam (2020) investigates considerable correlation between ICT expansion, e-government and institutional quality. Evans (2018) shows that ICT positively and statistically significantly affects public sector management.

Similarly, Uyar et al. (2021) research explores the potential relationship between tax evasion and the digitisation of government operations. Park & Kim (2020) proposed that e-government lessens corruption globally. Elbahnasawy (2014) explore The interaction effects between internet adoption and e-government and shows that both are complementary in anticorruption initiatives. The digitisation of government operations encourages productivity and efficiency in the public sector (Bai et al., 2021). Therefore, effective e-government efforts promote accountability and openness, increasing government efficiency.

The current revolution in the digital economy and e-government has profoundly influenced social welfare. The emergence and acceptance of ICT by society and the general public as a facilitator of the connection between the digitisation of governmental operations is relevant to increased public revenue. The impact of ICT and e-government has been extensively examined in the literature on fiscal, monetary and other macroeconomic indicators. However, using the best available information, a sparse analysis was carried out on the impact of ICT and e-government in South Asia. The current study aims to empirically evaluate the effect of ICT and e-government on public revenue. This study's findings will benefit the fiscal analyst in considering e-government and ICT's role in elevating public revenue.

2. Research Design and econometric model

Modernisation theory provides the fundamental basis for our theoretical approach. According to Barker (2003), the modernisation theory holds that technological advancements benefit modernised societies more than less technologically advanced ones. Countries with more excellent macro-environmental resources, such as a developed infrastructure for technology, broad ICT usage, and regular access to the internet, may profit more from e-government services (Adam & Alhassan, 2021). A better degree of tax submission and a low unemployment rate are examples of social changes brought on by technical advancements in government services that result in more effective government administration. According to Njoh (2018), e-government acts as a tool for improving and promoting accountability, good governance, and openness, thereby increasing the government's efficiency and effectiveness and making it much easier for citizens to access government programmes and services.

In light of this assertion, the modernisation theory enables us to demonstrate how e-government activities affect government performance and the production of public income, given the type and structure of our research. Based on this economic theory, the linear general regression model can be written as follows:

$$Rev_{it} = \alpha_1 + \alpha_{k2} ICT_{kit} + \alpha_3 fdi_{it} + \alpha_4 inf_{it} + \alpha_5 rem_{it} + \alpha_6 merch_{it} + \alpha_7 rol_{it} + \varepsilon_{it} \quad (1)$$

$$Rev_{it} = \alpha_1 + \alpha_2 ICT_{it} + \alpha_3 fdi_{it} + \alpha_4 inf_{it} + \alpha_5 rem_{it} + \alpha_6 merch_{it} + \alpha_7 rol_{it} + \varepsilon_{it} \quad (2)$$

$$Rev_{it} = \alpha_1 + \alpha_2 egov_{it} + \alpha_3 fdi_{it} + \alpha_4 inf_{it} + \alpha_5 rem_{it} + \alpha_6 merch_{it} + \alpha_7 rol_{it} + \varepsilon_{it} \quad (3)$$

Where Rev_{it} represents Government revenue, that is our dependent variables, t = 1, 2, 3…T represent the time dimension (annual) and i = 1, 2…, N represent the cross-sectional unit. In the equation 1, k=1, 2, …,5 for the following five indicators used to measure ICT in this context. The indicators include Fixed Telephone Subscriptions (FTS), Fixed Broadband

Subscriptions (FBS), Mobile Broadband Subscriptions (MBS), Internet Users (IU), Mobile Phone Subscriptions (MPS), and Fixed Broadband Subscriptions (FTS). The high correlation between these measurements makes simultaneous assessments prone to multicollinearity issues. The other control variables are foreign direct investment (fdi), inflation (inf), remittance (rem), merchandise trade (merch), and the rule of law (rol).
The research uses a panel dataset on South Asian countries spanning 2001 to 2021. The definition and sources of the variables used in the study are presented in Table 1.

Table 1: Definition of variable

Variables	Definition of variable	Source
	Dependent variable	
Public Revenue (% of GDP)	It is determined by dividing the Total Revenue for a certain Period by the GDP.	World Bank (2021)
	Independent Variable (Focused Variables)	
Mobilephone Subscriptions (per 100 people) MPS	Mobile phone telephone subscriptions are categorised using the number of post-paid subscriptions to public telephone service and the number of repaid active accounts (accounts that have been utilised within the last three months).	International Tele. Union (2021)
Internet Users (per 100 people) IU	People who have used the internet in the last 12 months (from any location) are considered internet users.	International Tele. Union (2021)
Fixed Telephone Subscriptions (per 100 people)	Voice over IP, fixed wireless local loop, fixed public payphone, and ISDN voice channel equivalents are all included in fixed telephone subscriptions.	International Tele. Union (2021)
Fixed Broadband Subscriptions (per 100 people)	This variable includes subscriptions to satellite, DSL, cable, and other types of broadband. Both business and household subscriptions are included in fixed broadband subscriptions.	International Tele. Union (2021)
Mobile Broadband Subscriptions (per 100 people)	Regardless of the device used to access the internet, mobile broadband subscriptions are plans for mobile cellular networks that provide access to data communications (such as the internet) at broadband rates. Don't leave anyone behind.	International Tele. Union (2021)
ICT Diffusion	This variable is the average of five (standardised) indicators, including the number of mobile phone subscriptions, fixed telephone lines, internet users, mobile broadband subscribers, and fixed broadband subscribers.	International Tele. Union (2021)
E-Government Index	The three weighted average normalised scores for the three e-government dimensions comprise the e-Government Index. The parameters are the quality and scope of online services (online service index), the telecommunication infrastructure (telecommunication infrastructure index), and the human capital index. The range of the index is 0 to 100.	United Nations (2021)
	Independent Variables (Control Variables)	
Foreign direct investment (% of GDP)	This data shows the net inflows (new investment minus withdrawals) of foreign capital into the reporting economy, broken down by GDP.	World Bank (2021)
Inflation	The annual percentage change in the average consumer's cost of acquiring a basket of goods and services is what the consumer price index uses to calculate inflation.	World Bank (2021)
Personal remittances received (% of GDP)	All recent cash or in-kind transfers from or to non-resident families by resident households are included in this category.	World Bank (2021)
Merchandise trade (%of GDP)	The total of merchandise exports and imports divided by the GDP value, all expressed in current U.S. dollars, yields the merchandise trade as a percentage of GDP.	World Bank (2021)
Rule of law	It is a robust system of regulations, institutional rules, and commitment to the community that upholds four universal principles: accountability, law, open government, and easy access and equitable justice.	Economist Intelligence Unit (EIU)

In the equations above, the independent factors and dependent variables had a time-variant relationship, and the sample was organised using a country-year longitudinal data set. Therefore, linear panel data regression analysis was the best analytical approach to evaluate the suggested models. According to Baltagi & Kao (2001), the likelihood of multicollinearity and estimation biases is decreased when using panel data regression analysis. Additional tests, including the F-test, the Breusch-Pagan Lagrange Multiplier (LM) test, and Hausman's test, were applied to analyse if linear panel regression with fixed-effects, random-effects, or pooled OLS should be conducted.
Compared to standard pooled OLS regression analysis, the F-test findings demonstrated that the FE panel regression technique was the most suitable method. The LM test showed that the latter was more appropriate when comparing panel data analysis with RE to the standard OLS regression method. Hausman's test (Hausman, 1978) showed that the fixed effect panel data

method outperformed the random effect panel data analysis. The outcomes of these tests indicate that the optimum method for analysing the data and evaluating the offered hypotheses was linear panel data regression analysis with FE. Still, when we used diagnostic tests, we discovered the issue of heteroskedasticity and serial correlation. This could lead to misleading and inefficient results. To overcome this problem, we use another Generalized Least Square method estimation technique.

3. Empirical findings and discussion

We presented descriptive statistics of the variables used in the study in Table A1. We also presented the correlation matrix of variables used in the analysis to observe the potential multicollinearity in the covariates (see Table A2). The examination of the correlation matrix is relevant when applying regression analysis. We also presented the scatter plot of the covariates against the dependent variable in Figures A1 and A2. We applied the regression analysis with alternative methodology specification.

3.1. Pooled OLS

The simple pooled OLS regression was applied to examine the impact of independent variables on dependent variables. ICT metrics are closely related to one another. We presented the aftermath of the pooled OLS model in Table 2. It depicts that a one scale point increase in mobile phone users results in a 0.01 per cent increase in income, as shown by model -1, which also shows that the coefficient on mobile phone subscriptions (MPS) is positive and substantial. Moreover, the value of R^2 =0.74 indicates that a 74% variation in the dependent variable occurs due to independent variables. The outcomes of this model support the theoretical claim that mobile phones are more widely available than other options in terms of geographic coverage, cost, and usability (Adam & Alhassan, 2021). The outcomes agree with those of Saidi and Mongi (2018). Mobile phone use contributes to overcoming the asymmetry of information in market transactions. Furthermore, to increase communication, cell phones stimulate citizens' curiosity and excess.

Table 2: ICT, E-Government and Public Revenue-OLS Estimation

VARIABLES	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6	Model-7
FDI	0.466***	0.531***	0.662***	0.597***	0.691***	0.474***	0.586***
	(0.0961)	(0.0935)	(0.0982)	(0.0837)	(0.0866)	(0.0960)	(0.144)
Inflation	-0.260***	0.232***	-0.330***	-0.269***	-0.0983	-0.247***	-0.257**
	(0.0715)	(0.0767)	(0.0760)	(0.0729)	(0.106)	(0.0723)	(0.110)
Remittance	0.122***	0.153***	0.148***	0.138***	0.212***	0.131***	0.163**
	(0.0437)	(0.0446)	(0.0425)	(0.0440)	(0.0455)	(0.0432)	(0.0624)
Merchandise	0.171***	0.172***	0.166***	0.170***	0.174***	0.171***	0.169***
	(0.0156)	(0.0163)	(0.0157)	(0.0164)	(0.0181)	(0.0157)	(0.0226)
Rule of law	5.928***	4.458**	7.870***	6.661***	3.839	5.412***	4.048
	(1.849)	(2.126)	(1.991)	(1.978)	(2.680)	(1.853)	(2.886)
MPS	0.0164***						
	(0.00571)						
Internet user		0.0287**					
		(0.0137)					
FBS			-0.132				
			(0.102)				
FTS				0.101*			
				(0.0581)			
Active MBS					0.0435***		
					(0.0124)		
ICT						0.0440***	
						(0.0160)	
e-gov							0.411**
							(0.164)
$(\text{e-gov})^2$							-0.00464**
							(0.00206)
Constant	3.337***	4.020***	4.328***	3.575***	2.208*	3.528***	-3.362
	(0.951)	(0.982)	(0.992)	(0.974)	(1.187)	(0.940)	(2.974)
Observations	124	119	111	124	83	124	60
R-squared	0.746	0.736	0.744	0.735	0.786	0.744	0.772

Standard errors in parentheses,*** p < 0.01, ** p < 0.05, * p < 0.1

Model 2 includes another ICT indicator, the number of internet users (IU) per 100 persons. According to the table, each scale point growth in internet users yields 0.02 per cent of public revenue. It suggests that the internet positively and significantly contributes to generating public revenue in South Asian countries. Furthermore, the regression model accounts for 74% of the variability observed in the target variable, as shown by the value of R^2. Using the internet helps eradicate flaws in market information while simultaneously lowering transaction costs. Similarly, increased use of digital services such as e-ticketing, e-finance, and e-commerce boosts market proficiency and economic growth rates. Moreover, internet use boosts labour force productivity by improving health outcomes (Majeed & Ayub, 2018).

Models 3 and 4 show the value of the parameter estimates for FBS (fixed broadband subscriptions) and FTS (fixed telephone subscriptions). R^2=0.74 in these models, indicating a 74% fluctuation in public revenue. FTS parameter estimations positively and considerably impact revenue in South Asian countries, whereas FBS has a negative but negligible impact. This indication shows that a one-scale-point increase in FTS results in a 0.10 gain in income, but a one-scale-point increase in FBS results in a

0.13 drop in revenue. Most South Asian countries have limited purchasing power and hence cannot pay the monthly FBS payments; additionally, these nations have fragile economies, political structures, and poor peace and order, which affects the relationship between FBS and state revenue. Because citizens more regularly utilise phone service, it is more easily managed than broadband service. Furthermore, landline phones are occasionally used as ADSL (asymmetric digital subscriber lines) to offer internet access. These findings corroborate Aker and Mbiti (2010) and Choi and Yi (2009).

Model 5 presents the results obtained using mobile broadband subscription (MBS) as an ICT metric. R^2 specifies that the regression model describes 79% of the variability seen in the target variable. This statistic has a favourable and considerable impact on South Asian countries' public revenue. It demonstrates that increasing MBS by one scale point increases public revenue by 0.04 per cent. The favourable relationship between telecommunications infrastructure and economic progress is consistent with Kaur and Malhotra's findings. (2014).

Model 6 displays the combined effect of all ICT measures through ICT diffusion. This factor strongly and favourably supports income development in the South Asian region. The table illustrates that ICT diffusion has a beneficial impact on South Asian countries' revenue. According to the coefficient of ICT diffusion, one scale point rise in ICT diffusion results in a 0.04 per cent gain in revenue. R^2=0.74 in this model, which shows that the regression model explains 74% of the variability in the target variable. Our findings are comparable with those of (Nisar, 2006), who discovered that using ICT can boost the efficiency of the public sector and lead to increased revenues.

Model 7 displays the results of the e-government index, which measures the widespread use of ICT in the government sector. According to its coefficient, one scale point increase in this index results in a 0.4 per cent increase in South Asia's public revenue. Furthermore, the regression model accounts for 77% of the variability in the target variable due to independent variables. Acceptance of e-government is a potential source of reducing bribery and tax evasion while making income generation more efficient and smoother in emerging economies. Adam and Alhassan (2021) emphasise the significance of e-government. They say that e-government supports the evolution procedure by reducing corruption and enabling a country's financial development and trade.

Regarding control factors, our conclusions are consistent with previous studies on public revenue. The effect of FDI, remittances, and merchandise is positive and significant in all regressions. In comparison, the rule of law affects the revenue positively and significantly in most regressions except 5 & 7. However, the revenue impact of price increases is negative. It is an indication of macroeconomic instability that has a negative impact on a country's economic performance.

3.2. Fixed Effects Estimation

The South Asian region is made up of a diverse mix of states. Due to missing variables that are specific to each nation, there can be bias. The fixed effects estimating approach is the best way to address such bias. Table 3 shows the findings achieved using fixed effects approaches.

Table 3 illustrates that most baseline findings are comparable, while marginal effects vary slightly when the fixed effects model is calculated. The coefficient for mobile phone subscriptions (MPS) is positive and significant, as seen in Model 1. showing that a one scale point rise in mobile phone users results in a 0.02 per cent gain in income. Undoubtedly, the twenty-first decade saw significant developments in mobile phone technology, notably in the South Asian region. Mobile phone usage is rapidly rising due to liberalisation policies; as a result, these countries are building out their information technology (IT) systems and receiving significant funding in the sector.

Mobile phone use facilitates overcoming the asymmetry of information in market transactions. Furthermore, increased mobile phone usage encourages citizen exploration and access to a better communication system. The result of R^2 indicates that the regression model 1 explains 61% of the variability seen in the target variable.

Model 2 shows another ICT statistic, the number of internet users (IU) per 100 people. The table demonstrates that each scale point rise in internet users yields 0.04 per cent of public money. It demonstrates that the internet favourably and significantly adds to the collection of public money in South Asian countries. The usage of the internet helps to address defects in market information while simultaneously lowering transaction costs. R^2 means that the regression model explains 60% of the variability in the target variable.

Model 3 shows the parameter estimates for fixed broadband subscriptions (FBS). The parameter estimations of FBS have a direct and considerable influence on the revenue of South Asian countries. This indication shows that a one-scale-point increase in FBS results in a 0.12 gain in revenue. Phone facilities have been obsolete since the development of mobile phones, although fixed broadband can now be built without a fixed telephone infrastructure. R^2= 47%, implying that the regression model explains the variability seen in the target variable.

Model 4 shows the parameter estimates for fixed telephone subscriptions (FTS). The parameter estimations of FTS have a negative but negligible impact on revenue. This indication shows that a one-scale-point increase in FTS results in a 0.13 drop in revenue. It also demonstrates that FBS's effect is more substantial than FTS's. Phone facilities have been obsolete since the development of mobile phones, although fixed broadband can now be built without a fixed telephone infrastructure. R^2 = 56% indicates that the regression model adequately captures the variability of the target variable.

Model 5 shows the findings using mobile broadband subscription (MBS) as an ICT metric. This measure has a direct and considerable influence on the public revenue of South Asian countries. It demonstrates that increasing MBS by one scale point increases public revenue by 0.04 per cent. The regression model's R^2 score reveals that it accounts for 56% of the variation in the objective variable.

Model 6 displays the combined effect of all ICT measures through ICT diffusion. This factor strongly and favourably supports income development in the South Asian region. The table illustrates that ICT diffusion has a beneficial influence on the income of South Asian countries. According to the coefficient of ICT diffusion, one scale point increase in ICT dissemination results in a 0.05 per cent gain in income. According to R^2, the regression model accounts for 61% of the fluctuation in the objective variable.

Model 7 displays the e-government index results that measure the acceptance of ICT in the public sector. According to its coefficient, one scale point increase in the index's value results in a 0.28 per cent increase in South Asia's public income. The

adoption of e-government is viewed as an effective means of regulating corruption and tax evasion and making the income production process more effective and smoother in developing economies. Gustova (2017) emphasise the significance of e-government. They say that e-government facilitates growth by reducing corruption and enabling a country's financial development and trade. R2 indicates that the regression model explains 66% of the variability seen in the target variable.

Regarding control variables, our results differ from the pooled model results for some variables but are similar to the literature on public revenue. The influence of remittances and merchandise is positive and substantial in all regressions. At the same time, the rule of law affects the revenue negatively and significantly in all the regressions except. It is because of the culture and economic situation of South Asian countries. In these countries, if there is a strict rule of law, then the efficiency of the economy will fall rather than rise after a certain point. Investors and business people will hesitate to work when there is more transparency. People also hesitate to show their proper wealth in this scenario. The revenue impact of inflation, on the other hand, is negative. It is a sign of an unstable macroeconomic environment, which has a negative impact on a country's economic performance.

Table 3: ICT, E-Government and Public Revenue- Fixed Effects Estimation

VARIABLES	Model -1	Model - 2	Model - 3	Model – 4	Model - 5	Model - 6	Model - 7
FDI	-0.0558	-0.0507	0.0300	0.0458	0.0410	-0.0736	0.135
	(0.0799)	(0.0836)	(0.0905)	(0.0831)	(0.104)	(0.0811)	(0.124)
Inflation	-0.179***	-0.150***	-0.206***	-0.170***	-0.147***	-0.172***	-0.127**
	(0.0420)	(0.0439)	(0.0480)	(0.0451)	(0.0546)	(0.0419)	(0.0625)
Remit	0.385***	0.420***	0.571***	0.477***	0.366***	0.387***	0.438***
	(0.0462)	(0.0447)	(0.0835)	(0.0446)	(0.0904)	(0.0455)	(0.0690)
Merchandise	0.0898***	0.0987***	0.0880***	0.0703***	0.103***	0.0955***	0.0761***
	(0.0178)	(0.0195)	(0.0204)	(0.0185)	(0.0273)	(0.0180)	(0.0248)
Rule of law	-8.607***	-10.33***	-7.081**	-7.418***	-15.33***	-9.586***	-9.379**
	(2.202)	(2.548)	(2.954)	(2.369)	(3.473)	(2.259)	(3.827)
MPS	0.0151***						
	(0.00370)						
Internet user		0.0355***					
		(0.00981)					
FBS			0.124*				
			(0.0691)				
FTS				-0.128			
				(0.0783)			
Active MBS					0.0413***		
					(0.00778)		
ICT						0.0467***	
						(0.0110)	
e-gov							0.286***
							(0.0996)
$(e\text{-}gov)^2$							-0.0026**
							(0.0012)
Constant	11.65***	12.10***	11.03***	12.78***	14.01***	11.71***	6.147***
	(1.242)	(1.352)	(1.788)	(1.498)	(2.097)	(1.237)	(2.233)
Observations	124	119	111	124	83	124	60
R-squared	0.611	0.604	0.471	0.562	0.564	0.614	0.655
Number of economies	8	8	8	8	8	8	8

Standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1

3.3. Generalised Least Square Regression

The results of applying the Wooldridge test for autocorrelation and the Modified Wald test for group-wise heteroskedasticity in the FE regression model demonstrate that our model has an autocorrelation problem, and heteroskedasticity overcomes this problem. We used another technique, Generalized Least Square (GLS). In the presence of heteroskedasticity and serial and cross-sectional correlations, the proposed GLS estimator outperforms the OLS by eliminating these problems (Bai et al., 2021). The coefficient of mobile phone subscriptions (MPS) is positive and highly significant in Model 1, showing that one scale point rise in mobile phone users results in a 0.01 per cent gain in public revenue. This finding matches Adam and Alhassan's (2021) findings—using mobile phones aids in improving market transactions. Furthermore, more use of cell phones allows exploration and access to global markets for emerging economies' products (Majeed & Malik, 2016).

Model no 2 displays another ICT statistic, the number of internet users (IU) per 100 people. The table also demonstrates that each rise of 0.02 scale points in internet users generates 0.05% income. It implies that the internet has a favourable and considerable impact on public revenue in South Asian countries. This observation matches the findings of Choi and Yi (2009). The usage of internet services helps to address defects in market information while simultaneously lowering transaction costs. Similarly, the rising use of e-services such as e-commerce, e-ticketing, and e-finance boosts market performance and economic growth conditions. In addition to this, internet use boosts labour force productivity by improving health outcomes (Majeed & Ayub, 2018).

The parameter estimates for fixed broadband subscriptions (FBS) and fixed telephone subscriptions (FTS) are presented in Models 3 and 4, respectively. FTS parameter estimations positively and considerably impact revenue in South Asian countries,

whereas FBS has a negative but negligible impact. This indication reveals that a one-scale-point increase in FTS results in a 0.10 increase in revenue, but a one-scale-point increase in FBS results in a 0.13 drop in revenue.

Most South Asian countries have limited purchasing power, making it impossible for them to pay the monthly FIXB charges; also, these nations have fragile economies and political structures and a poor law and order situation, all of which impair the relationship between FIXB and state revenue. Because citizens more commonly utilise phone service, it is easier to manage than broadband service. Furthermore, with the emergence of mobile broadband, fixed broadband is becoming less efficient and outdated. These findings are congruent with those of Choi and Yi (2009).

Model no 5 shows the findings taken by employing mobile broadband subscription (MBS) as an ICT metric. This measure has a considerable and positive impact on the public revenue of South Asian countries. It indicates that increasing MBS by one scale point increases public revenue by 0.04 per cent.

Model 6 displays the combined effect of all ICT measures through ICT diffusion. The results of the ICT index are displayed in Table 5.3's second-to-last column. According to the parameter results on the ICT diffusion, the overall effect of ICT leads to development and is a potential way to grow in the South Asian region. ICT has a considerable positive influence at the 1% level of significance. The ICT coefficient implies that one scale point rise in ICT produces a 0.04 per cent increase in public income in South Asia.

Model no 7 displays the outcome of the e-government development index that measures the involvement and use of ICT in the government sector. Its coefficient shows that one scale point increase in this index results in a 0.41 per cent increase in South Asia's public income. The introduction of e-government is viewed as a viable source of regulating corruption and tax evasion, making the income production process more effective and straightforward in developing economies. Gustova (2017) emphasise the significance of e-government. They say that e-government facilitates development by reducing bribery and enabling a country's financial development and trade.

Table 4: Cross-sectional time-series GLS regression

Variables	Model – 1	Model – 2	Model - 3	Model - 4	Model - 5	Model - 6	Model – 7
FDI	0.466***	0.531***	0.662***	0.597***	0.691***	0.474***	0.586***
	(0.0933)	(0.0907)	(0.0950)	(0.0813)	(0.0829)	(0.0932)	(0.134)
Inflation	-0.260***	-0.232***	-0.330***	-0.269***	-0.0983	-0.247***	-0.257**
	(0.0695)	(0.0744)	(0.0736)	(0.0709)	(0.101)	(0.0702)	(0.102)
Remit	0.122***	0.153***	0.148***	0.138***	0.212***	0.131***	0.163***
	(0.0424)	(0.0433)	(0.0412)	(0.0428)	(0.0436)	(0.0420)	(0.0580)
Merchandise	0.171***	0.172***	0.166***	0.170***	0.174***	0.171***	0.169***
	(0.0152)	(0.0158)	(0.0152)	(0.0159)	(0.0173)	(0.0153)	(0.0210)
Rule of law	5.928***	4.458**	7.870***	6.661***	3.839	5.412***	4.048
	(1.796)	(2.062)	(1.927)	(1.921)	(2.564)	(1.800)	(2.687)
MPS	0.0164***						
	(0.00555)						
Internet user		0.0287**					
		(0.0133)					
FBS			-0.132				
			(0.0988)				
FTS				0.101*			
				(0.0564)			
Active MBS					0.043***		
					(0.0119)		
ICT						0.0440***	
						(0.0156)	
e-gov							0.411***
							(0.153)
$(e\text{-}gov)^2$							-0.0046**
							(0.00192)
Constant	3.337***	4.020***	4.328***	3.575***	2.208*	3.528***	-3.362
	(0.923)	(0.953)	(0.960)	(0.946)	(1.136)	(0.913)	(2.769)
Observations	124	119	111	124	83	124	60
Number of economy	8	8	8	8	8	8	8

*** p < 0.01, ** p < 0.05, * p < 0.1

Regarding control variables, our results are similar to the pooled model and previous studies on public revenue. In all regressions, the influence of remittances and merchandise is positive and substantial. The rule of law has a beneficial impact on revenue and is very significant in all regressions. It demonstrates that improved circumstances of the rule of law can raise revenue in South Asian countries. However, the revenue effect of inflation is negative. It is a sign of macroeconomic instability that has a negative impact on a country's economic performance.

This method produces superior results than prior estimation strategies since all major indicators directly and substantially impact South Asia's public revenue. The influence of e-government is quite significant, meaning that the execution of ICT infrastructure in the government sector can help this region greatly. Table 5.3 further illustrates that, except for inflation, all other control variables have a positive impact on the economic performance of South Asian economies. Meanwhile, the empirical evidence (Majeed and Malik, 2016) supports the negative impact of inflation. These statistics suggest that spending on ICT infrastructure and its use in the public sector can help South Asian economies greatly.

4. Discussion

The findings show that mobile phone subscription (MPS), internet user (IU), fixed telephone subscription (FTS), mobile broadband subscription (MBS), and ICT diffusion all have a favourable and substantial effect on public revenue, with e-government also having a favourable and substantial effect on South Asia's public revenue. The parameter estimates for the several ICT indicators vary barely, with the minimal effect of an active mobile broadband subscription being comparatively more prominent than the marginal impact of the other ICT proxies. ICT diffusion metrics show that a 0.04 scale point increase in ICT creates a 0.04 per cent increase in public income, with a marginal impact of 14.7. Our findings indicate that technological advancement, which affects every element of life, impacts and improves the functioning of government organisations.

Our findings show that e-government has a significant favourable influence in the region. The e-government coefficient demonstrates that a one-scale-point increase in the e-government index generates a 0.44 per cent increase in public income in South Asian nations. Still, its marginal impact is 14.9, which is greater than ICT. It may be inferred that using e-government is a possible way of regulating bribery and tax evasion and making the income collection process more effective and smoother in South Asian countries. Our study, which incorporates many proxies of digital change in government, adds to the body of knowledge on using e-government systems to increase the payment of taxes and generate income (Night and Bananuka, 2019). In terms of service providers using a variety of digital opportunities for service delivery, our results demonstrate how ICT can increase the effectiveness of public services (Adam, 2020). More precisely, our analysis confirms the connection between e-government and government revenue mobilisation, indicating that digitising public services may promote transparency and contribute to revenue creation. Evidence suggests that improvement in the effectiveness and productivity of government operations leads to lesser bureaucratic corruption and, as a result, more revenue creation (Park and Kim, 2020; Kerandi, 2015). In addition to demonstrating the favourable effects of technical development and ICT adoption for social transformation, the study underlines the advantages of digitalisation in public sector operations, including tax compliance and its potential to boost revenue compliance.

5. Conclusion

Based on the findings above, we may speculate that ICT and e-government are responsible for generating public money in South Asia. The study's findings propose that South Asian countries should strengthen their ICT infrastructure. Furthermore, e-government research indicates that South Asian countries must strengthen ICT deployment in the public sector. Conversely, FDI, remittances, and merchandise trade positively contribute to South Asian countries' revenue. In addition, efficient rule of law situations also promote revenue, whereas inflation needs to be kept in check over time to prevent a negative impact on GDP. The study suggests that introducing ICT promotes public revenue, so policymakers should focus on ICT infrastructure development by stimulating ICT investment to increase public revenue. ICT eventually becomes obsolete due to the market introduction of contemporary technology, and wireless technologies are taking on greater significance in the digital sphere. It is necessary to enhance digital literacy and upgrade infrastructure and digital connectivity. The benefits of ICTs for boosting productivity and enabling innovation at the level of the person, the business, and the industry collectively support economic growth and the creation of new public funding sources. Furthermore, e-government research suggests that South Asian countries should strengthen ICT deployment in the public sector. Ensure efficiency, transparency and accountability by using integrated government databases and applications. To facilitate effective data exchange among and with citizens, new projects should be planned to build data centre hubs at strategic locations and link government databases and software systems. Government organisations should allocate specialised IT personnel for ownership, change management, and the effective implementation of e-government initiatives and programmes.

Reference

Adam, I. O. (2020). ICT development, e-government development and economic development. Does institutional quality matter? *Information Technologies & International Development*, *16(7)*, 1-19.

Adam, I. O., & Alhassan, M. D. (2021). The linkages between ICT access, e-government and government effectiveness and its effect on corruption. *International Journal of Technology, Policy and Management*, *21*(4), 344-362.

Aker, J. C., & Mbiti, I. M. (2010). Mobile phones and economic development in Africa. *Journal of economic Perspectives*, *24*(3), 207-232.

Alam, T., Aftab, M., Abbas, Z., Ugli, K. M. M., & Bokhari, S. A. A. (2023). Impact of e- government initiatives to combat corruption mediating by behavioral intention: A quantitative analysis from emerging economies *sustainability*, *15*(3), 26-54.

Ali, M., Raza, S. A., Puah, C. H., & Arsalan, T. (2021). Does e-government control corruption? Evidence from South Asian countries. *Journal of Financial Crime*, *29*(1), 258-271.

Audi, M., Ali, A., & Al-Masri, R. (2022). Determinants of Advancement in Information Communication Technologies and its Prospect under the role of Aggregate and Disaggregate Globalization. *Scientific Annals of Economics and Business*.

Audi, M., Ali, A., & Roussel, Y. (2021). The Advancement in Information and Communication Technologies (ICT) and Economic Development: A Panel Analysis. *International Journal of Innovation, Creativity and Change*, 15(4), 1013-1039.

Backus, M. (2001). E-governance and developing countries, introduction and examples. *International Institute for Communication and Development (IICD)*, *1*(3).

Bai, J., Choi, S. H., & Liao, Y. (2021). Feasible generalised least squares for panel data with cross-sectional and serial correlations. *Empirical Economics*, *60*, 309-326.

Baltagi, B. H., & Kao, C. (2001). Nonstationary panels, cointegration in panels and dynamic panels: A survey. In *Nonstationary panels, panel cointegration, and dynamic panels* (pp. 7-51). Emerald Group Publishing Limited.

Barker, D. J. (2003). The developmental origins of adult disease. *European journal of epidemiology*, 733-736.

Casella, B., Bolwijn, R., Moran, D., & Kanemoto, K. (2019). Improving the analysis of global value chains: the UNCTAD-Eora Database. *Transnational Corporations*, *26*(3), 115-142.

Castro, C., & Lopes, C. (2022). Digital government and sustainable development. *Journal of the Knowledge Economy*, *13*(2), 880-903.

Choi, C., & Yi, M. H. (2009). The effect of the internet on economic growth: Evidence from cross-country panel data. *Economics Letters*, *105*(1), 39-41.

Elbahnasawy, N. G. (2014). E-government, internet adoption, and corruption: an empirical investigation. *World Development*, *57*, 114-126.

Evans, O. (2018). Digital government: ICT and public sector management in Africa.

Gustova, D. (2017). *The impact of e-government strategy on economic growth and social development* (Doctoral dissertation, ISCTE-Instituto Universitario de Lisboa (Portugal)).

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica: Journal of the econometric society*, 1251-1271.

Holt, L., & Jamison, M. (2009). Broadband and contributions to economic growth: Lessons from the US experience. *Telecommunications Policy*, *33*(10-11), 575-581.

Javid, A. Y., & Arif, U. (2012). Analysis of revenue potential and revenue effort in developing Asian countries. *The Pakistan development review*, 365-379.

Kerandi, A. M. (2015). *E-government and the transformation of public administration in developing countries: a case study of the kenya revenue authority* (Doctoral dissertation, Université d'Ottawa/University of Ottawa).

Khan, F. N., & Majeed, M. T. (2020). ICT and e-Government as the sources of economic growth in information age: Empirical evidence from South Asian economies. *South Asian Studies*, *34*(1).

Latif, Z., Xin, W., Khan, D., Iqbal, K., Pathan, Z. H., Salam, S., & Jan, N. (2017). ICT and sustainable development in South Asian countries. *Human Systems Management*, *36*(4), 353-362.

Mahyideen, J. M., Ismail, N. W., & Hook, L. S. (2012). A pooled mean group estimation on ICT infrastructure and economic growth in ASEAN-5 countries. *International Journal of Economics and Management*, *6*(2), 360-378.

Majeed, M. T., & Ayub, T. (2018). Information and communication technology (ICT) and economic growth nexus: A comparative global analysis. *Pakistan Journal of Commerce and Social Sciences (PJCSS)*, *12*(2), 443-476.

Majeed, M. T., & Malik, A. (2016). Does E-government stimulate press freedom to curb corruption? A cross-country study. *Pakistan Journal of Social Sciences*, *36*(2), 1173-1183.

Night, S., & Bananuka, J. (2020). The mediating role of adoption of an electronic tax system in the relationship between attitude towards electronic tax system and tax compliance. *Journal of Economics, Finance and Administrative Science*, *25*(49), 73-88.

Nisar, T. (2006). E-governance in revenue collection and administration. *The Internet Society II: Advances in Education, Commerce and Governance, Internet and Society*, 265-274.

Njoh, A. J. (2018). The relationship between modern information and communications technologies (ICTs) and development in Africa. *Utilities Policy*, *50*, 83-90.

Park, C. H., & Kim, K. (2020). E-government as an anticorruption tool: Panel data analysis across countries. *International Review of Administrative Sciences*, *86*(4), 691-707.

Rahman, H. U., Ali, G., Zaman, U., & Pugnetti, C. (2021). Role of ict investment and diffusion in the economic growth: a threshold approach for the empirical evidence from Pakistan. *International Journal of Financial Studies*, *9*(1), 14.

Saidi, K., & Mongi, C. (2018). The effect of education, R&D and ICT on economic growth in high income countries. *Economics Bulletin*, *38*(2), 810-825.

Salatin, P., & Fallah, H. (2014). Impact of information and communication technology (ICT) on governance quality. *European Online Journal of Natural and Social Sciences*, *3*(2), pp-250.

Shair, W., Hussain, S., Asif, M., & Niamat, A. (2024). Financial Inclusion, Sustainability, and Financial Wellbeing in OIC and Non-OIC Countries. In *Financial Inclusion, Sustainability, and the Influence of Religion and Technology* (pp. 164-185). IGI Global.

Shair, W., Tayyab, M., Nawaz, S., & Amjad, k. (2023). Digital divide in Pakistan: Barriers to ICT adoption. *Bulletin of Business and Economics (BBE)*, *12*(2), 243-252.

Shair, W., Waheed, A., Kamran, M. M., & Kubra, N. (2022a). Digital Divide in Pakistan: Barriers to ICT usage among the individuals of Pakistan. *Journal of Economic Impact*, *4*(3), 196-204.

Shair, W., Zahra, T., Tayyab, M., & Kubra, N. (2022b). The impact of the digital divide on wage gaps among individuals in Pakistan. *Journal of Policy Research*, *8*(4), 97-107.

Shim, D. C., & Eom, T. H. (2009). Anticorruption effects of information communication and technology (ICT) and social capital. *International review of administrative sciences*, *75*(1), 99-116.

Uyar, A., Nimer, K., Kuzey, C., Shahbaz, M., & Schneider, F. (2021). Can e-government initiatives alleviate tax evasion? The moderation effect of ICT. *Technological Forecasting and Social Change*, *166*, 120597.

Zanden, J. L. van . (2023). Bridging the Divide: Information and Communication Technology and Financial Access in Africa. Journal of Business and Economic Options, 10(3).

Appendix

Table A1: Descriptive statistics

Variable	Observation	Mean	Standard deviation.	Min value	Max value	Skewness	Kurtosis
Total Revenue	155	14.80	4.53	8.87	22.20	0.01	0.00
FDI	166	1.95	2.86	-0.68	17.13	0.00	0.00
Inflation	162	6.24	4.18	-6.81	26.42	0.00	0.00
Remittance	156	6.21	6.54	0.08	27.63	0.00	0.00
Merchandise	167	45.13	18.21	19.31	102.80	0.16	0.20
Role of law	135	0.38	0.16	0.031	0.66	0.01	0.00
MPS	168	61.70	47.96	0	190.52	0.00	0.05
Internet user	161	17.25	20.64	0.00	85.76	0.00	0.00
FBS	141	1.97	2.72	0.00	14.67	0.00	0.00
FTS	163	3.96	4.078	0.02	17.31	0.00	0.00
Active MBS	96	29.15	27.16	0 .00	100.61	0.00	0.71
ICT	168	20.93	17.12	0.04	66.89	0.00	0.60
EG	80	35.09	12.57	11.75	67.08	0.25	0.30

Table A2: Correlation matrix

	TR	FDI	inf	remitt	Mercha	Rule of law	MPS	internet	FBS	FTS	MBS	ICT	e-gov
Total revenue	1.00												
FDI	0.60	1.00											
Inflation	-0.19	-0.43	1.00										
Remittance	-0.10	-0.46	0.27	1.00									
Merch	0.69	0.39	-0.03	-0.41	1.00								
Rule of iaw	0.29	-0.27	0.20	0.48	0.11	1.00							
MPS	0.48	0.65	-0.55	-0.12	0.15	-0.08	1.00						
Internet user	0.55	0.49	-0.58	-0.25	0.36	0.20	0.73	1.00					
FBS	0.23	0.65	-0.56	-0.26	0.10	-0.16	0.78	0.69	1.00				
FTS	0.09	0.19	-0.18	-0.03	0.08	-0.22	0.50	0.27	0.41	1.00			
MBS	0.17	-0.29	-0.39	0.12	-0.10	0.43	0.24	0.58	0.18	0.02	1.00		
ICT	0.52	0.63	-0.60	-0.18	0.24	0.00	0.97	0.88	0.82	0.49	0.38	1.00	
e-gov	0.10	0.30	-0.45	-0.10	-0.10	-0.00	0.70	0.66	0.67	0.54	0.43	0.75	1.00

Table A3: ICT, E-Government and Public Revenue-Random Effects Estimation

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
FDI	0.466***	0.00512	0.115	0.0878	0.0663	0.300***	0.586***
	(0.0961)	(0.0905)	(0.0976)	(0.0828)	(0.103)	(0.102)	(0.144)
Inflation	-0.260***	-0.167***	-0.224***	-0.182***	-0.148***	-0.224***	-0.257**
	(0.0715)	(0.0488)	(0.0526)	(0.0456)	(0.0556)	(0.0644)	(0.110)
Remit	0.122***	0.369***	0.409***	0.457***	0.330***	0.176***	0.163***
	(0.0437)	(0.0465)	(0.0751)	(0.0448)	(0.0831)	(0.0476)	(0.0624)
Merchandise	0.171***	0.130***	0.117***	0.0821***	0.120***	0.169***	0.169***
	(0.0156)	(0.0191)	(0.0204)	(0.0183)	(0.0261)	(0.0167)	(0.0226)
Rule of law	5.928***	-7.304***	-3.817	-6.194***	-12.68***	2.461	4.048
	(1.849)	(2.524)	(2.835)	(2.335)	(3.321)	(2.000)	(2.886)
MPS	0.0164***						
	(0.00571)						
Internet user		0.0390***					
		(0.0104)					
FBS			0.101				
			(0.0758)				
FTS				-0.0884			
				(0.0770)			
Active MBS					0.0404***		
					(0.00785)		
ICT						0.0486***	
						(0.0148)	
e-gov							0.411**
							(0.164)
$(e\text{-}gov)^2$							-0.00464**
							(0.00206)
Constant	3.337***	9.645***	9.326***	11.82***	11.95***	4.674***	-3.362
	(0.951)	(1.445)	(1.796)	(1.966)	(2.319)	(1.032)	(2.974)
Observations	124	119	111	124	83	124	60
Number of economy	8	8	8	8	8	8	8

Standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1

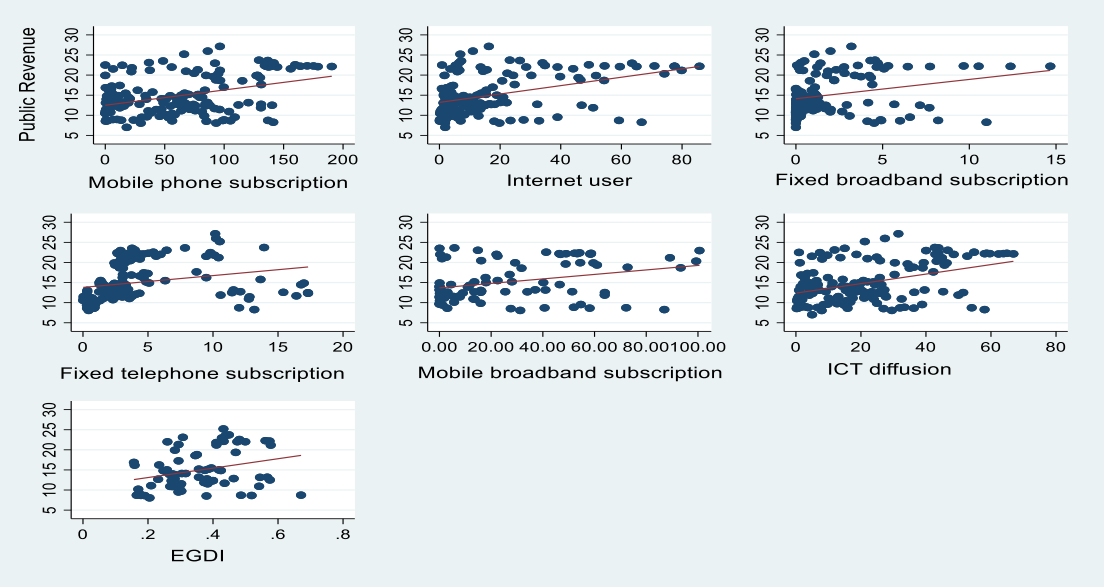
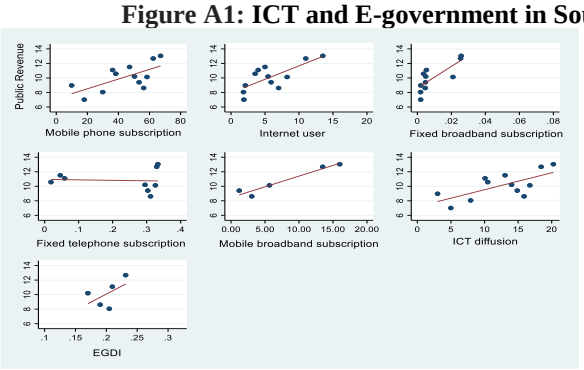


Figure A1: ICT and E-government in South Asian countries for pooled data



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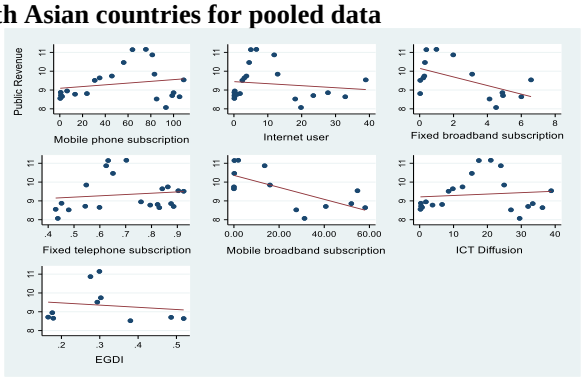
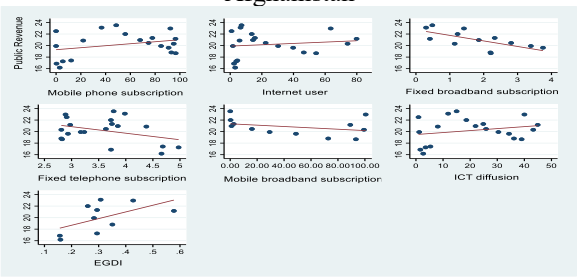
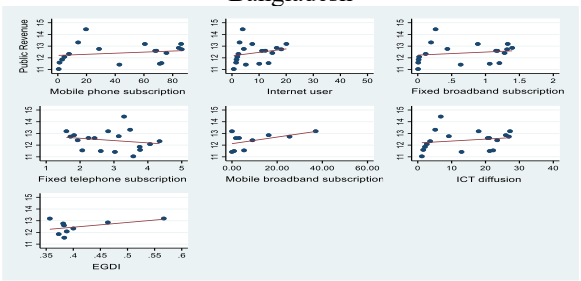


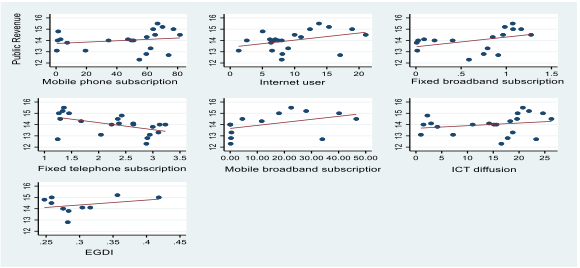
Bangladesh



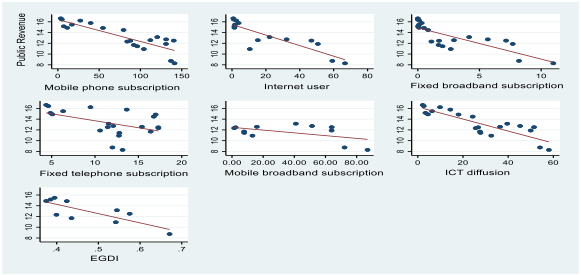
Bhutan



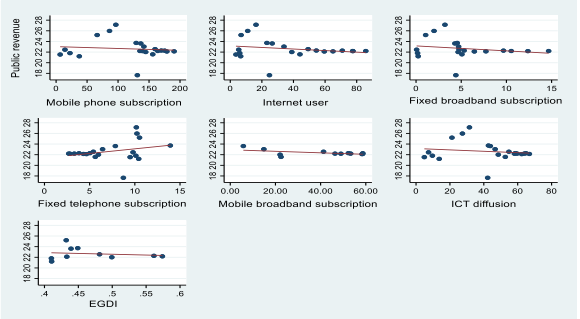
India



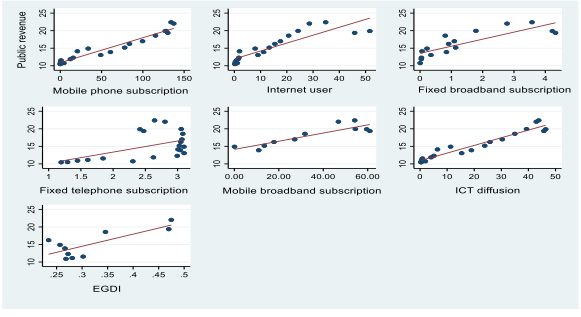
Pakistan



Sri Lanka



Maldives



Nepal

Figure A2: ICT and E-government in South Asian countries