Spread of Information and Communication Technology (ICT) and Economic Growth in 5-Pacific Islands: A Panel Study

Pacific Update

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Keshmeer Makun
School of Economics
University of the South Pacific

TK Jayaraman
Faculty of Business, Accounting, Finance and Economics
University of Tunku Abdul Rahman, Malaysia

Outline

- Brief background –ICT and growth in the PICs
- Literature review
- Theoretical background & Methodology
- Findings
- Conclusion and implications

Information and communication technology

- Enable/strengthening collaboration between economic agents
- Promoting innovative capacity of countries
- Improving firm level productivity
- Providing access to a wide range of affordable products and services
- Giving rise to new employment opportunities
- Improving corporate and public sector governance
- Enabling marginalized segments of society to information and resources for business development

ICT in PICs

- Remains a growing sector
- In last 2 decades PICs: substantial growth in ICT, including internet facilities.
- Investing in underwater fiber optic cables & reforms in telecommunication sector
- No longer telecommunications are monopolies in PICs
- Deregulation policies : A key driver of increased ICT penetration since early 2000.
- Tonga: first to deregulate its telecoms sector in 2003
- Gradually improved coverage, service quality and fall in price of mobile phone & subscription fees
- Rapid expansion of subscribers, resulting in near-universal penetration– except in very remote locations.
- The ICT revolution has brought rapid growth of the ICT sector, and especially of mobile phone services.

ICT in PICs

- According to GSMA (2016) - Fiji has the highest unique subscriber penetration rates for mobile phones (83 percent)
- followed by Palau (64 percent)
- Tonga (58 percent)
- Vanuatu (53 percent)
- Solomon Islands (47 percent)
- Samoa (43 percent)

- In most of the other countries, about one-half of the population has a mobile phone subscription.
- About 50 percent of Fiji's population also has access to the Internet through mobile phones.

Literature

- Three Schools of thought
- First: *supply-leading hypothesis*
- ICT penetration: pre-condition for growth & development
- Economic agents: become more connected to the information highway;
- Extend their reach to obtain more information, knowledge, products, services & markets.
- improve their productivity, enhance innovations & wealth creation opportunities.
- World Bank (2017a) – ICT to be primary transformer for economic processes (production and trade)
- Kumar et al. (2015)

Literature Review (Contd)

- Second school of thought : *demand following hypothesis*
- Higher economic growth & increase spending on ICT development.
- Rising Income levels: Demand for more sophisticated technology:
- Governments invest a significant amount of resources to develop & upgrade ICT infrastructure,
- Support systems & regulatory environment (Beil et al. (2005), Lee et al. (2012), Pradhan et al (2013a) and Shiu and Lam (2008a).

Literature Review (Contd)

- Third school of thought: the *feedback hypothesis* (FBH)
- There is bi-directional causality
- While ICT deepens growth, growth encourages investments in ICT
- Govt investments in ICT: raise number of users and upgrade ICT
- Source: (Pradhan 2012; Chakraborty and Nandi (2009, 2011), Wolde-Rufael (2007); & Zahra et al. (2008).

Theoretical background & Methodology

- Neoclassical model of Solow (1956)
- Technological factor (Solow residual) :
- Since growth is discussed to be influenced by technology, digital era is in favour of technological factors.

$$y_t = A_t k_t^{\alpha} \qquad 0 < \alpha < 1$$

- y : output per capita.
- A : stock of technology (TFP)
- k : is stock of capital
- α: share of capital.

Theoretical background & Methodology

- Solow equation:

$$A_t = A_{0^{e^{gt}}}$$

- Effect of ICT and other variables on technology

  enter as shift variable with capital as a conditioning variable.
- Hence: $A_t = f(MOB_t, FDI_t, EXP_t)$
- MOB-mobile subscription per 100 inhabitant
- For estimation purpose:

$$ly_t = \alpha_0 + \alpha_1 lk + \beta_1 lMOB + \beta_2 LFDI_t + \beta_3 LEXP_t + \varepsilon_t$$

Data

- Panel of five PICs (Fiji Islands, Samoa, Solomon Islands, Tonga and Vanuatu),
- Period of 16 years (2002-2017)
- Objective: Examine the effects of ICT, on real GDP per capita.
- Fundamental variable: capital stock
- Supportive Variables: To minimize bias arising from omitted variables & ensure robustness of the relationship.
- Dependent variable: Real GDP per capita (in 2010 US dollars),
- Shift variable: ICT: mobile subscription per 100 inhabitant;
- FDI & export (percent of gdp) as control variables
- Real GDP per capita, ICT, Exports & FDI: WDI (World Bank, 2018)
- Capital stock data is obtained from Pen World Tables.

Methodology: Estimation and results

- Panel estimation
- Two models: Pooled OLS (POLS) & Fixed effect Model
- POLS: benchmark for the estimation, where the assumption is that there is no individuality between countries, that is, all countries have the same coefficient.
- The assumption is not realistic (Gujarati and Porter, 2009).
- Countries: varying requirements with investment policies (Avgerou, 2003).
- Fixed effect model is more appropriate: time invariant to control for unobserved heterogeneity across economies.

Unit root Tests

Table 1. Panel unit root test results.					
Variables	Test statistics (probability values)				
Panel A: In Level	LLC	IPS	MW(ADF)	MW(PP)	
ly	0.6718 (0.2508)	0.9722 (0.8345)	5.9727 (0.8175)	6.2992 (0.7895)	-
lk	2.8548 (0.3221)	0.8068 (0.2089)	13.430 (0.2006)	16.197 (0.0941)	-
lMOB	1.9162 (0.4277)	0.7177 (0.7636)	5.6669 (0.8424)	7.7835 (0.6500)	-
lFDI	2.3075 (0.2105)	0.3390 (0.3673)	10.231 (0.4204)	14.827 (0.1385)	
lEXP	0.9352 (0.1748)	0.5732 (0.2833)	11.028 (0.3553)	13.669 (0.1886)	-
Panel B: In First Difference					
ly	3.3075 (0.000)	2.4030 (0.008)	23.235 (0.009)	31.605 (0.000)	I (1)
lk	6.1825 (0.000)	1.9369 (0.026)	24.071 (0.007)	6.0151 (0.000)	I (1)
lMOB	2.8945 (0.001)	2.3198 (0.010)	21.940 (0.015)	40.616 (0.000)	I (1)
lFDI	1.9207 (0.027)	2.5427 (0.005)	23.691 (0.008)	86.313 (0.000)	I(1)
lEXP	5.6599 (0.000)	4.0625 (0.000)	35.573 (0.000)	53.437 (0.000)	I (1)

Note: LLC and IPS indicate Levin et al. (2002) and Im et al. (2003) panel unit root test. MW (ADF) and MW (PP) represent Maddala and Wu (1999) Fisher-ADF and Fisher-PPpanel unit root tests. The LLC, IPS, MW (ADF) and MW (PP) all inspect null hypothesis of non-stationary. The values I n brackets are probability values.

Long run cointegration

Table 2. Panel cointegration tests		
Panel cointegration (Within-dimension)	Test statistics	P-Value
Panel v-Stat	-1.435322	0.0756***
Panel rho-Stat	-2.039402	0.0207**
Panel PP-Stat	-1.904073	0.0285**
Panel ADF-St	-2.12980	0.0166**
Panel cointegration (Between-dimension)		
Group rho-Stat	2.341439	0.9904
Group PP-Stat	-2.614633	0.0045*
Group ADF-Stat	-2.241223	0.0125**

Note: *, ** and *** denote significance at 1%, 5% and 10% level respectively.

Long run regression estimates

Table 3. Estimated regression coefficient		
	POLS	FEM
Variables	coefficient	coefficient
lk	0.451(0.01)*	0.442(0.00)*
lMOB	0.079(0.00)*	0.049(0.01)**
LEXP	0.019(0.03)**	0.106(0.316)
lFDI	0.233(0.02)*	0.163(0.00)*
Constant	7.847(0.00)	3.198(0.02)
R square	0.847	0.791
DW stats	2.30	2.76
Jarque-Bera (p-value)	0.231	0.728

Note: The two regressions are estimated with Whites period coefficient covariance to avoid possible heteroscedasticity. DW is Durbin Watson test for autocorrelation. * and ** denotes significance at 1% and 5% level respectively. Figures in parenthesis are the probability values.

RESULTS

- Economically sound results.
- Capital stock is significant positive for the two models
- Share of capital stock: 0.451% & 0.442%.
- Coefficient of ICT Variable (*lMOB*) is positive & statistically significant
- Elasticity of GDP per capita with respect to MOB is 0.07 to 0.04.
- Decrease in the impact of ICT is noticed when controlling for unobserved heterogeneity with fixed effect.
- Inference : Pace of ICT is different in different PICs, as reforms in ICT sector take place at different pace

Results (Contd)

- Performance of export variable is Consistent with Romer (1990) and Dollar and Kraay (2002).
- It is positive.
- However, as a control variable though important, is insignificant when accounting individual country characteristics.
- Insignificance is due to some measurement issues
- Reality is that small PICs with limited export commodities often find it hard to compete in world market
- Reasons: remoteness from key markets; high cost of doing business, effects of climate change that affects supply chain.

Results (Contd)

- When controlling for FDI, we find positive and significant results for both model.
- However, the effect of FDI in fixed effect model is somewhat reduced.
- This perhaps all countries do not attracted same level of foreign investments.
- Some of the relatively smaller PICs such as Samoa and Tonga received comparatively low levels of FDI.

Conclusion and policy implications

- ICT is a significant driver of growth in the PICs.
- We estimate that ICT could contribute between 0.05 and 0.08 percentage points to real GDP growth.
- ICT contribution to growth could be higher where ICT has the greatest potential to generate growth effects (for instance, in tourism, transport, education etc.)
- Greater penetration is needed
- Since, mobile penetration rates still be significantly below 85 percent in the most PICs, additional efforts to reach a penetration rate of 85 percent could enhance income further for PICs.

Conclusion and policy implications

•PICs countries face particularly severe challenges in terms of geography and affordability for low-income populations.

•It also important to note that the dispersion of PICs across many islands implies that once the main population centers are covered, expanding mobile access to remote regions and islands will entail significant cost and effort.

To this end:

•Completing market liberalization, enabling additional investment in infrastructure and services is important.

•Targeted approaches to connect remote/outer islands, including Public/Private Partnership investments and, where feasible, mobilization of new technologies is critical.

Conclusion and policy implications

Policy implications: Clear & Straight Forward

- Further technical and financial investment
- Enhance skills – starting at the primary level
- Upgrade learning materials to develop the capacity of students
- Raise the levels of curriculum to meet the demands of the changing workplace in the Pacific region and beyond

Conclusions & Policy Implications

- Stimulate innovation and entrepreneurship locally;
- Support online transactions and facilitate secure e-commerce; payments and transactional systems.
- Provide enabling environment for the digital economy –
- Strengthen legal/regulatory frameworks

Thank you.