Estimating economic impact of ICTs for small Island States in the Pacific

- Dr Christoph Stork
Why bother?

- Policy and development planning - decide on how to allocate scarce resources
  - roads, bridges, schools, clinics, fibre networks....
- Convince policy makers of the importance on ICTs
- Estimate payoffs for investments into ICTs
- Return on investment: Economic growth and employment increase = increase in tax income

Myanmar - Hakha: 2nd bridge or broadband coverage?
Direct Macro Economic Impact

- National accounts: GDP contribution of communication sector

- Different measurements:
  - Communications Sector
  - Information and Communications Sector
  - Communication and Transport Sector
  - ISIC 3.1 or ISIC 4

- ICT sector not an ISIC sector (like tourism) hence
  - retailing handsets, computers and airtime not captured e.g.
  - satellite accounts are required to capture direct impacts
Direct GDP per capita contribution of Communications Sector in USD

<table>
<thead>
<tr>
<th>Year</th>
<th>Fiji</th>
<th>Samoa</th>
<th>Vanuatu</th>
<th>Tonga</th>
<th>Solomon Islands</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>206</td>
<td>133</td>
<td>118</td>
<td>29</td>
<td>79</td>
</tr>
<tr>
<td>2009</td>
<td>219</td>
<td>159</td>
<td>111</td>
<td>29</td>
<td>92</td>
</tr>
<tr>
<td>2010</td>
<td>212</td>
<td>208</td>
<td>92</td>
<td>28</td>
<td>117</td>
</tr>
<tr>
<td>2011</td>
<td>221</td>
<td>177</td>
<td>171</td>
<td>28</td>
<td>127</td>
</tr>
<tr>
<td>2012</td>
<td>231</td>
<td>153</td>
<td>117</td>
<td>19</td>
<td>126</td>
</tr>
<tr>
<td>2013</td>
<td>235</td>
<td>169</td>
<td>132</td>
<td>16</td>
<td>122</td>
</tr>
</tbody>
</table>

Countries: Fiji, Samoa, Vanuatu, Tonga, Solomon Islands
Indirect Macro Economic Impact

- Productivity gains through ICTs in other sectors
- Two way causality between economic growth and mobile broadband penetration is undisputed
- Supported by economic theory and anecdotal evidence
- Exact amount is more complex to estimate
  - Change in total factor productivity
  - Change in GDP growth (excluding ICT sector)
Estimating Indirect Impact

- **Country specific modelling:**
  - Most appropriate for policy and regulatory purposes
  - Requires quarterly GDP, employment, investment and price data

- **Cross section modelling:**
  - Effect size = average of selected countries
  - More data by including more countries

- **Panel data modelling:**
  - Is a combination of time series data and cross country analysis
  - Maximises data availability (countries and years)
  - Allows to derive country specific results
  - Allows to derive year specific results
**IMPACT MODEL OF INCREASING BROADBAND PENETRATION ON GDP GROWTH**

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>EQUATION</th>
</tr>
</thead>
</table>
| Aggregate Production Function | $\Delta \text{GDP}_{it} = \alpha_1 \Delta \text{Fixed Capital}_{it} + \alpha_2 \Delta \text{Labor Force}_{it} + \alpha_3 \Delta \text{Oil Price}_{it}$  
  $+ \alpha_4 \Delta \text{Broadband Penetration}_{it} + \epsilon_{it} + \text{Year Fixed Effect}_{t}$ |
| Demand function               | $\Delta \text{Broadband Penetration}_{it}$  
  $= \alpha_1 \Delta \text{Broadband Price}_{it} + \alpha_2 \Delta \text{Household Income}_{it} + \epsilon_{it}$  
  $+ \text{Year Fixed Effect}_{t}$ |
| Supply function               | $\Delta \text{Revenues of Broadband Companies}_{it}$  
  $= \alpha_1 \Delta \text{Household Income}_{it} + \alpha_2 \Delta \text{Urban Population}_{it} + \epsilon_{it}$ |
| Output function               | $\Delta \text{Broadband Penetration}_{it} = \alpha_1 \Delta \text{Revenues of Broadband Companies}_{it} + \epsilon_{it}$ |
Impact of mobile penetration on economic growth in developing countries

Period averages and initial values and not annual data - thus suffering to an lesser extent from data unavailability

\[
\text{GDP}_{8006} = \alpha_0 + \alpha_1 \cdot \text{GDP}_{80} + \alpha_2 \cdot (I/Y_{8006}) + \alpha_3 \cdot \text{TELEPEN}_{8006} + \alpha_4 \cdot \text{PRIM}_{80} + \alpha_6 \cdot \text{SSA} + \alpha_7 \cdot \text{LAC} + \mu,
\]

\text{GDP}_{8006} = \text{Average growth rate of real GDP per capita in US$ for the period 1980–2006}

\text{GDP}_{80} = \text{Real GDP per capita in 1980}

\text{I/Y}_{8006} = \text{Average share of investment in GDP for 1980–2006}

\text{TELEPEN}_{8006} = \text{Average telecommunications penetration per 100 people over 1980–2006 (Number of main lines or mobile subscribers or Internet users or Broadband subscribers)}

\text{PRIM}_{80} = \text{Primary school enrolment rate in 1980}

\text{SSA} = \text{Dummy variable for countries in the Sub-Saharan Africa Region}

\text{LAC} = \text{Dummy variable for countries in the Latin America and Caribbean Region}
## Data Availability

<table>
<thead>
<tr>
<th></th>
<th>Fiji</th>
<th>Vanuatu</th>
<th>Tonga</th>
<th>Samoa</th>
<th>Solomon Islands</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital Stock</strong></td>
<td>NSO</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Telco Capital Expenditure (CAPEX)</strong></td>
<td>From operators</td>
<td>2000-2013 ATH &amp; Digicel</td>
<td>2007-14 Digicel only</td>
<td>2007-14 Digicel only</td>
<td>2007-14 Digicel only</td>
</tr>
<tr>
<td><strong>Labour force with secondary education</strong></td>
<td>NSO</td>
<td>Estimates for selected years based on Labour force and HIES surveys</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Katz & Koutroumpis (family of models) could not be applied due to data limitation.
- Qiang et al. (2009) is across countries and requires large number of countries.
  - Data availability means that pacific countries drop out of analysis in large numbers.
  - Sensitive to global shocks.
World’s GDP growth compared to World’s mobile subscriber numbers

Global Financial Crisis
Fiji

Mobile cellular subscriptions (per 100 people)

GDP per capita growth (annual %)

Mobile subscriber numbers per 100 inhabitants

GDP per capita growth in %


-2.3 1.6 3.0 0.9 5.1 0.3 1.2 0.0 -1.7 -2.3 1.0 1.4 2.0

0 2.5 5 7.5 10

-5 -2.5 0 2.5 5
Vanuatu: GDP growth compared to mobile subscribers

- Mobile cellular subscriptions (per 100 people)
  - 2000: 3.8
  - 2001: -5.6
  - 2002: -7.4
  - 2003: 1.7
  - 2004: 1.3
  - 2005: 2.7
  - 2006: 5.8
  - 2007: 2.6
  - 2008: 3.9
  - 2009: 0.9
  - 2010: -0.7
  - 2011: -1.1
  - 2012: -0.5
  - 2013: 0.6

- GDP per capita growth (annual %)
  - 2000: 0.6
  - 2001: -0.5
  - 2002: -1.1
  - 2003: -0.7
  - 2004: 0.9
  - 2005: 3.9
  - 2006: 2.6
  - 2007: 5.8
  - 2008: 2.7
  - 2009: 1.3
  - 2010: 1.7
  - 2011: -7.4
  - 2012: -5.6
  - 2013: 3.8
Applying Effect Sizes to the Pacific

- Applying the x% increase for y% higher increase
- Short cut in absence of data
- Effect size from global studies = average
  - (no-one is average)
- Fixed -line: no relevance in Pacific
- Mobile Broadband:
  - fairly new, last 5 years
  - increased with submarine cable rollout
Additional GDP Per Capita in US$ through mobile penetration increase for period 2005 - 2014

Fiji: 348
Samoa: 207
Solomon Islands: 151
Tonga: 80
Vanuatu: 94

Direct and indirect impact!

Waverman et al (2005)
Qiang et al. (2009)
Fiji: Comparing effect sizes (direct and indirect impact) to national accounts (direct impact)

Change in GDP per capita USD

- GDP per capita USD growth based on Waterman et al (2005)
- GDP per capita USD growth based on Qiang et al. (2009)
- Change in direct GDP per capita in USD for Information and communication sector

<table>
<thead>
<tr>
<th>Year</th>
<th>Waterman et al. (2005)</th>
<th>Qiang et al. (2009)</th>
<th>Change in direct GDP per capita in USD for Information and communication sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>24.8</td>
<td>34.0</td>
<td>-24.8</td>
</tr>
<tr>
<td>2010</td>
<td>13.7</td>
<td>14.4</td>
<td>-18.1</td>
</tr>
<tr>
<td>2011</td>
<td>19.8</td>
<td>9.8</td>
<td>10.0</td>
</tr>
<tr>
<td>2012</td>
<td>20.3</td>
<td>9.7</td>
<td>10.6</td>
</tr>
<tr>
<td>2013</td>
<td>22.1</td>
<td>4.2</td>
<td>17.9</td>
</tr>
</tbody>
</table>

Effect size tracks the direct impacts closely.
Conclusion

- Regulators should monitor KPIs and prices quarterly and require all licensees to furnish audited financial statements.
- Effective regulation without data is hardly possible.
- Statistical agencies may need to expand their data collection:
  - Labour force surveys and national income and expenditure surveys can deliver crucial ICT indicators.
  - ICT satellite accounts would greatly enhance the measurement of direct impacts of the ICT sector.
- The indirect impacts can be best measured by separating direct and indirect impacts.
  - Katz and Koutroumpis (2012) etc. would ideally be run to test for indirect impact only.
  - The direct GDP contribution should be excluded from the models.