The Relationship between Internet Usage and Gross National Income of an Emerging Economy

FENNEE CHONG
Faculty of Business Management (Finance)
Universiti Teknologi MARA
Jalan Meranek, 94300 Kota Samarahan
MALAYSIA
fennee.chong@sarawak.uitm.edu.my

VENUS K HIM-SEN LIEW
Faculty of Economics and Business
Universiti Malaysia Sarawak
94300 Kota Samarahan
Sarawak, Malaysia
Email: ksliew@feb.unimas.my

ROSITA SUHAIMI
Faculty of Business Management
Universiti Teknologi MARA
Jalan Meranek, 94300 Kota Samarahan
MALAYSIA

Abstract: - This study examines both the long-run and short-run relationships between the internet usage rate and the gross national income per capita of an emerging economy – Malaysia. Empirical findings from the econometrics analysis of a thirteen years time series found that there is a significant long-run and short-run relationship between these two variables. Therefore, enhancing internet usage among the public and private sectors is a relevant strategy towards achieving a higher national income status for the people in this country.

Key- Words: - Gross national income per capita, internet usage rate.

1 Introduction
Emerging economy such as Malaysia has strived hard to do well on the world economy platform. Among others, the New Economy Model has been introduced in 2011 aiming to transform the nation into a high income, inclusive and sustainable economy in the near future. Nevertheless, it is important to recognize that the future prosperity cannot be achieved without linkages to the world economy. One of the key enablers for moving up the global value chain is via the innovation eco-system which emphasis on R&D and ICT enhancement. With that in mind, internet usage is a viable ICT infrastructure which allows Malaysia’s transition into a high income nation.

As at 2010, the gross nation income for Malaysia stands at USD 7760. There is a high gap if compared to the envisaged target of USD 15,000 per capita by 2020. According to economic theory, higher income can only be achieved via greater productivity which in turn required higher level of innovations, technologies and highly skilled workforce (Aghion and Howitt (1992) [1]. With that in mind, Malaysia needs to adopt the knowledge economy model. Since ICT is the major technology that brings innovations to greater heights coupled with the arises of a globalized economy, therefore, advances into “information economy” is also inevitable within the knowledge economy model.

2 Problem Formulation
From the literature, microeconomic factors such as interest rates, foreign exchange rates, money supply and oil prices are endogenous factors affecting a nation’s wealth (Flannery and Protopapadakis, 2002 [4] and Liow et. al., 2005 [6]). On the other hand, the impact of information economy components such as internet usage on the gross national income is rarely examined for developing country such as Malaysia. Apart from the reason that this topic is relatively new, most of the studies on internet usage
are focused on the industry or firm level instead of the macro scale.

2.1 Literature Review

Intensifying technology usage such as internet usage is crucial as it lowers the barriers in doing business and allowing more innovations involving cutting edge processes and products at the same time. In addition, diffusion of the internet is an ICT innovation that can promote cheaper communication and allows more efficient and faster dissemination of information worldwide. In the past decade, Malaysia’s total internet usage rate has grown from 2.3 per 100 people in 1997 to 55 per 100 people in 2010 (World Bank database, 2011) [12]. Despite its growing trend, the total internet usage is consider as low if compared with the Newly Industrialized Economies and other emerging economies such as Korea and Singapore. This is partially due to the fact that ICT infrastructure was not made available in the rural area.

Numerous empirical literatures documented positive impact of ICT usage particularly on the productivity and growth at the firm level. Ark et al. (2003) [2] examined labour productivity growth of 51 industries in Europe and United States. He found that U.S. productivity has grown faster than that of Europe due to its more intensive use of ICT.

On the macro level, Gius and Ceccucci (2010) [5] documented that nation which impede economic activity, discourage human development and retard entrepreneurial endeavour generally have less internet usage. Tiwari (2008 )[11] reported that ICT usage has a significant positive impact on the economic development and poverty diminution in poorer countries. This finding was supported by a later research conducted by Dimelis and Papaioannou (2010) [3] which contended that there is a highly positive and significant ICT usage effect in developing countries.

2.2 Methodology

This study utilised the annual data covers a period of 13 years from 1997 to 2010. Data on gross national income per capita (GNI), and internet user rate (INT) are obtained from World Bank database. All data are logarithmic transformed before applied for further analysis. The time series plots show an increasing trend for LGNI and LINT over the sample period of study.

In order the determine if there exist any relationship between LGNI and LINT, the autoregressive distributed lag (ARDL) bounds testing framework pioneered by Pesaran and Shin (1995, 1999) [8][10] is adopted in this study. This approach is suitable for small sample size used in this study. Another advantage of this approach is it could be adopted for variables with mixed integration orders of I(0) and I(1).

Based on this approach, the regression equations in the ARDL \((m, n)\) framework to be estimated in this study are as in Equation 1 below:

\[
\Delta \text{lgni}_t = \sum_{i=-1}^{m} \beta_i \text{lgni}_{t-i} + \alpha_2 \text{lint}_{t-1} + \sum_{i=1}^{n} \beta_i \Delta \text{lint}_{t-i} + \gamma_i \Delta \text{lint}_{t-i} + c + \varepsilon_t
\]

Where \(\Delta\) is the first difference operator, \(\text{lgni}\) and \(\text{lint}\) represent logarithmic forms of gross national product and internet user rate variables respectively. The optimal lag order \(m\) and \(n\) needs to be predetermined by objective criteria while \(\varepsilon\) is a series of random errors. The parameters to be estimated include \(\alpha\)'s, \(\beta\)'s and \(\gamma\)'s. The intercept, \(c\) is included in the estimation. Nonetheless, the parameters of interest are \(\alpha\)'s.

The null and alternative hypotheses for regression Equation (1) are,

\[H_0: \alpha_1 = \alpha_2 = 0\] (There is no long-run relationship between GNI and INT),

and

\[H_1: \alpha_1 \neq \alpha_2 \neq 0\] (There exists a long-run relationship between GNI and INT).

The null hypothesis could be rejected in favour of the alternative hypothesis if the computed \(F\)-statistics exceeds its upper bound critical values. Since the \(F\)-statistics in the ARDL framework does not follow standard distribution and therefore need to be simulated. These critical values are available in Pesaran et al (2001) [9].

3 Analysis and Findings

As the ARDL bound testing approach is suitable for I(0) or I(1) variable, unit root test is applied to ensure that the LGNI and LINT variables are not integrated of higher order. To achieve this objective, the conventional ADF test is performed and the results are reported in Table 1. From Table 1, it can be seen that LGNI is stationary after first differencing, while LINT is already stationary in its level form. Thus, we can conclude that LGNI and LINT are integrated of order 1 and 0 respectively. In other words, LGNI is an I(1) variable while LINT is
an I(0) variable. As such, ARDL approach is relevance for this study.

Table 1: Unit Root Test for Order of Integration

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unit Root Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level</td>
</tr>
<tr>
<td>LGNI</td>
<td>-2.394 [0.362]</td>
</tr>
<tr>
<td>LINT</td>
<td>-18.093 [0.000]</td>
</tr>
</tbody>
</table>

Notes: The optimal lag of the ADF test is selected based on AIC, with a maximum lag of 2. The regression equation for the level of LGNI is estimated with a trend and intercept, while for LINT, only intercept is included in the estimation. The value included in the square brackets next to the reported t-statistic is the p-value of the statistic.

For the estimation of the ARDL procedure, the choice of optimal lag is important. Pesaran and Shin (1999) [10] show that out of the two commonly used minimum information criteria, namely Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC), the latter perform better in the ARDL setting. Furthermore, for annual data like the current study, Pesaran and Shin (1999) [10] suggest to choose the optimal lag from a maximum lag of 2. Consequently, SBC is adopted to choose the optimal lag from a maximum of 2 lags.

The results are reported in Table 2. It is obvious from Table 2 that based on SBC (note that AIC consistently has chosen the same), ARDL (2, 1) is the appropriate specification, and the F-statistic obtained is larger than the 1% upper bound critical value. Hence, it can be concluded that there is a long-run relationship between the LGNI and LINT.

Table 2: Bounds Test for Long-run Relationship

<table>
<thead>
<tr>
<th>Order of ARDL(m, n)</th>
<th>F-statistic</th>
<th>AIC</th>
<th>SBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2, 1)</td>
<td>8.398***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.411</td>
<td>4.158</td>
</tr>
<tr>
<td>(2, 2)</td>
<td>6.663**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.370</td>
<td>4.080</td>
</tr>
</tbody>
</table>

Notes: The 10, 5 and 1% critical values l(0) are 4.04, 4.94 and 6.84 respectively for with unrestricted intercept with no trend ; while the critical values for l(1) are, in that order, 4.78, 5.73 and 7. 84 These values are reproduced from Table CI.iii (with an unrestricted intercept and no trend; with one regressor) in Pesaran et al., 2001). Asterisks ** and *** denotes rejection of null hypothesis at 5 and 1% significant level respectively.

Having established the long-run relationship, the ARDL (m,n) dynamic model is estimated for the derivation of long-run elasticity. The resulting optimal model based on SBC and a battery of diagnostic tests is reported in Table 3. Referring to Table 3, this model has passed through a battery of diagnostic tests, implying the estimated model is valid for interpretation. From Equation (2) as reported in Table 3, it can be seen that the first lagged values of LGNI and LINT have significant positive impact on the current values of LGNI. The plot of CUSUM statistic was reported well within the 5% critical bounds, implying the estimated coefficients are stable.

Table 3: Estimated ARDL Dynamic Model for Long-run Elasticity

\[
\text{LGNI}_t = 0.870 + 0.857\text{LGNI}_{t-1} + 0.115\text{LINT}_{t-1} \quad (2)
\]

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th></th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breusch-Pagan-Godfrey</td>
<td>1.202</td>
<td>0.341</td>
</tr>
<tr>
<td>Heteroscedasticity Test</td>
<td>0.532</td>
<td>0.766</td>
</tr>
<tr>
<td>Jarque-Bera Normality Test</td>
<td>2.042</td>
<td>0.192</td>
</tr>
<tr>
<td>Breusch-Godfrey Serial Correlation LM Test</td>
<td>0.884</td>
<td>0.399</td>
</tr>
<tr>
<td>Ramsey RESET Test</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The long-run elasticity can be calculated from Equation (2) and the resulting long-run model is \(\text{LGNI}_t = 6.804 + 0.804\text{LINT}_t\). \(\text{(3)}\)

Equation (3) reveals that INT and GNI are positively related, whereby a 10% change in INT can be associated to a 8% change in GNI in the same direction.

The estimated optimal error correction representation of ARDL model based on SBC and a battery of diagnostic tests is reported in Table 4. It can be observed from Table 4 that LINT has significant short-run positive impact on LGNI. Moreover, the error correction term (EC) is negative.

\(^1\) The slope coefficient is given by 0.870/ (1-0.857) =6.840, whereas the slope coefficient is given by 0.115/ (1-0.857) =0.804, see Obben and Nugroho (2006) [12].
and significant at 5% level, implying that LGNI is responsive to short-run disequilibrium, in order to restore long-run equilibrium.

Table 4: Error Correction Representations of ARDL Model

\[ \Delta \text{LGNI}_t = -0.009 + 0.885 \Delta \text{LGNI}_{t-1} + 0.214 \Delta \text{INT}_t - 1.392 \text{EC}_t \]

<table>
<thead>
<tr>
<th>s.e.</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0.028)</td>
<td>(0.214)</td>
</tr>
<tr>
<td>(0.108)</td>
<td>(0.459)</td>
</tr>
<tr>
<td>[0.763]</td>
<td>[0.003]</td>
</tr>
<tr>
<td>[0.084]</td>
<td>[0.016]</td>
</tr>
</tbody>
</table>

Goodness-of-fit

- R-squared = 0.833
- F-statistic = 13.346
- AIC = -4.025
- SBC = -3.863

Diagnostic test

<table>
<thead>
<tr>
<th>Test</th>
<th>Statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breusch-Pagan-Godfrey Test</td>
<td>1.408</td>
<td>0.315</td>
</tr>
<tr>
<td>Heteroscedasticity Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jarque-Bera Normality Test</td>
<td>0.660</td>
<td>0.719</td>
</tr>
<tr>
<td>Breusch-Godfrey Serial Test</td>
<td>1.408</td>
<td>0.315</td>
</tr>
<tr>
<td>Correlation LM Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ramsey RESET Test</td>
<td>0.746</td>
<td>0.480</td>
</tr>
</tbody>
</table>

Note: EC is the first lagged values of the residuals of Equation (2).

4 CONCLUSION

The empirical findings provided by this study show that there is a significant long-run and short-run relationship between gross national income and internet usage rate in Malaysia. Therefore, investing in ICT infrastructure particularly promoting a higher internet usage is beneficial to improve the gross nation income per capita of Malaysia. With that, we conclude that enhancing internet usage should be made as one of the important components in the New Economy Model so that the vision and mission of this policy can be achieved in the future. Future research should also examine the internet user’s profile and the characteristics of the internet usage.

References:


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