

INFORMATION COMMUNICATION TECHNOLOGY, HUMAN CAPITAL AND ECONOMIC GROWTH IN MALAYSIA: AN EMPIRICAL ANALYSIS

Jarita Duasa

Department of Economics, International Islamic University Malaysia, Kuala Lumpur, Malaysia
E-mail: jarita@iium.edu.my

Norjaimah Mohd Jais

²
Department of Economics, International Islamic University Malaysia, Kuala Lumpur, Malaysia
E-mail: jaimahjais@yahoo.com

ABSTRACT

The present study aims to investigate the relationship between economic growth, human capital and Information Communication Technology (ICT) in Malaysia in short and long run. Using time series data, the study adopts Autogressive Distributed Lag (ARDL) cointegration technique that applies the bound testing to examine the existence of the relationship between variables. The results suggest that in long run, economic growth is positively determined by capital, labour, ICT and human capital. In the short run, labor, capital and ICT contribute positively and significantly to economic growth but human capital negatively affects growth. The results imply that Malaysian government should undertake better policies that facilitate human capital development along with investment in ICT to boost economic growth of the country in short and long run.

Keywords: Information communication technology (ICT); economic growth; Autoregressive Distributed Lag (ARDL) model

Introduction

No nation would deny the importance of human capital and Information and Communication Technology (ICT) for the economic growth. Human capital is defined as the knowledge and skill embodied in every worker and ICT is defined as the use of electronic tools, such as telephone, fax, computer, laptop, among others in everyday transactions. Other than capital and employment, human capital and ICT would contribute to labour productivity in a country (Elsadiq, 2008), thus economic growth (Asongu and Roux, 2016). The issue of human capital and technology contributing to economic growth is seriously paid attention by academicians and policy makers especially in developing countries and the results were mixed (see for example Jin and Cho, 2015; Erumban and Das, 2016; Jorgenson and Vu, 2016 and others). Study on this issue using time series analysis is also relatively thin in Malaysia. Thus, the present study intends to fill the gap by analysing the importance of human capital and ICT to economic growth in Malaysia.

Data and methodology

The model is based on the endogenous growth theory, in which economic growth is determined by physical capital, labour, human capital and technology improvement (Romer, 1986; Lucas, 1988; and Barro, 1991). The present study employed Malaysian time series data (yearly data) to analyze the relationship between human capital, ICT and economic growth from 1970 until 2015. All data are transformed into natural logarithm (see Table 1). The reason is because time series are heteroskedastic and it is likely that a stationary or integrated model can be fitted after the transformation.

Submit Date: 10.07.2018, Acceptance Date: 22.08.2018, DOI NO: 10.7456/1080SSE/189

Research Article - This article was checked by Turnitin

Copyright © The Turkish Online Journal of Design, Art and Communication

Table 1: Data and Variables

Data / Variable	Measurement	Sources of data
Real Gross Domestic Product, GDP (lnY _t)	RM(mil.)	Department of Statistics, Malaysia (DOSM)
Real Gross Capital Formation (lnK)	RM(mil.)	DOSM
Numbers of employment (lnL)	Unit	DOSM
Education expenditure (lnHC)	RM(mil.)	Ministry of Finance, Malaysia
Numbers of fixed line subscriber (lnICT)	Unit	World Bank

Autoregressive Distributed Lag (ARDL) cointegration technique is applied to examine the relationships among the variables in both short run and long run. The advantage of this method of cointegration is in avoiding spurious regression that resulted from any combination of stationary and non-stationary variables which are common characteristic found in economic data. In fact, this technique is robust for small sample studies (Kuppusamy and Shanmugam, 2007). Basically, the ARDL approach to cointegration (see Pesaran et al., 2001) involves estimating the conditional error correction (EC) version of the ARDL model for national income and its determinants as follows:

$$\Delta \ln(Y)_t = \alpha_0 + \sum_{i=1}^p \phi_i \Delta \ln(Y)_{t-i} + \sum_{i=0}^p \theta_i \Delta \ln(K)_{t-i} + \sum_{i=0}^p \lambda_i \Delta \ln(L)_{t-i} + \sum_{i=0}^p \varphi_i \Delta \ln(HC)_{t-i} + \sum_{i=0}^p \Delta \ln(HC)_{t-i} + \delta_1 \ln(Y)_{t-1} + \delta_2 \ln(K)_{t-1} + \delta_3 \ln(L)_{t-1} + \delta_4 \ln(HC)_{t-1} + \delta_5 \ln(ICT)_{t-1} + v_t \quad (1)$$

If there is evidence of long-run relationship (cointegration) of the variables, the following long-run model is estimated:

$$\ln(Y)_t = \alpha_1 + \sum_{i=1}^p \phi_{1i} \ln(Y)_{t-i} + \sum_{i=0}^p \beta_{1i} \ln(K)_{t-i} + \sum_{i=0}^p \theta_{1i} \ln(L)_{t-i} + \sum_{i=0}^p \lambda_{1i} \ln(HC)_{t-i} + \sum_{i=0}^p \sigma_{1i} \ln(ICT)_{t-i} + \mu_t \quad (2)$$

The ARDL specification of the short-run dynamics can be derived by constructing an error correction model (ECM) of the following form:

$$\Delta \ln(Y)_t = \alpha_2 + \sum_{i=1}^p \phi_{2i} \Delta \ln(Y)_{t-i} + \sum_{i=0}^p \theta_{2i} \Delta \ln(K)_{t-i} + \sum_{i=0}^p \lambda_{2i} \Delta \ln(L)_{t-i} + \sum_{i=0}^p \varphi_{2i} \Delta \ln(HC)_{t-i} + \sum_{i=0}^p \sigma_{2i} \Delta \ln(ICT)_{t-i} + \psi ECT_{t-1} + \vartheta_t \quad (3)$$

where ECT_{t-1} is the error correction term which is developed from cointegrating vector.

In addition, various diagnostic tests are conducted to ensure that the residuals of the model satisfy the standard regularity condition. These involve the Lagrange Multiplier (LM) test for serial correlation, White test for heteroskedasticity, the Auto-regressive conditional heteroskedastic (ARCH) test and Jarque –Bera test for normality of the residuals.

Findings and analysis

Even though the ARDL framework does not require pre-testing variables to be done, the unit root tests have shown that there is a mixture of I(1) and I(0) of underlying regressors and therefore, the ARDL testing are proceeded. Equation (1) is estimated in order to analyze the long run relationship among

variables. We apply the Schwarz- Bayesian criteria (SBC) to determine the optimal number of lags in the conditional error correction. The lag length chosen by SBC is one. The result for the *F*- test for the cointegration is shown in Table 2. The *F*- statistics of 5.9071 is higher than upper bound critical value at 1 per cent significant level using restricted intercept and no trend. This indicates that the null hypothesis of no cointegration among variables is rejected at 1 per cent level of significant. Thus, there is cointegration among the variables.

Table 2 F-statistics for cointegrating relationship

Test statistics	Value	Lag	Sig. level	Bound Critical Values*(restricted intercept and no trend)		Bound Critical Values*(restricted intercept and trend)	
				I(0)	I(1)	I(0)	I(1)
F statistic	5.9071	1					
			1%	4.280	5.840	4.768	6.670
			5%	3.058	4.223	3.354	4.774
			10%	2.525	3.560	2.752	3.994

Note: * base on Narayan (2004)

In addition, the long run model which is developed by normalizing on real GDP is presented in Table 3. The significant variables which appear to effect economic growth in the long run are capital, labour, human capital and ICT. The results are expected and confirmed by findings of past studies such as Teixeira and Natercia (2004), Norhanani (2010), Kuppusamy and Shanmugam (2007), Elsadiq (2008 and 2011) and Jorgenson & Vu (2016) that found ICT and human capital are positive and significant to economic growth in the long run.

Table 3 Long Run Model

Dependent Variable: ln(Y)	Independent variables			
	lnK	lnL	lnHC	lnICT
	0.1977** (0.0405)	0.8212** (0.6900)	0.0182* (0.0133)	0.0382** (0.2318)

Note: standard error in parentheses; ** significant at 5%; * significant at 10%

The results for the error correction model (ECM) are presented in Table 4. The significant and negative sign of an error correction term (ECT_{t-1}) coefficient shows the evidence of causality in at least one direction. The coefficient indicates high rate of convergence to equilibrium. Any deviation from the long-run equilibrium is corrected about 123 per cent for each period to return to the long-run equilibrium level. Furthermore, the diagnostic tests in the model indicate no evidence of serial correlation or heteroskedastic problems. The model also passes the Jarque-Bera normality test which indicates that the error terms are normally distributed.

Table 4 Error Correction Model for Economic Growth

Dependent variable : $D(\ln Y)_t$			
Independent variable	Coefficient		
Constant	-0.000550 (-0.0305)	Adj R ²	0.9383
$D(\ln Y)_{t-1}$	0.3339 (1.1342)	F-statistic	25.8726***
$D(\ln K)_t$	0.2205***(12.0479)	DW-statistic	1.5586
		Diagnostic Test:	

$D(\ln K)_{t-1}$	-0.1151** (-1.7854)	<i>Jarque-Bera</i> <i>Fhet</i> <i>ARCH</i> <i>LM</i>	0.6286
$D(\ln L)_t$	1.4442*** (2.7779)		1.1181
$D(\ln L)_{t-1}$	-0.2515 (-0.5812)		0.1762
$D(\ln HC)_t$	-0.0217**(-2.4150)		5.538
$D(\ln HC)_{t-1}$	-0.0100 (-0.9647)		
$D(\ln ICT)_t$	0.2239** (2.1088)		
$D(\ln ICT)_{t-1}$	-0.2015* (-1.8269)		
ECT_{t-1}	-1.2322*** (-3.6346)		

Note: 1. t-statistic in parentheses
2. JB normal is the Jarque-Bera Statistic of the Normality Test; Fhet is the F-statistic of the White Heteroskedasticity Test, Auto-regressive conditional heteroskedastic (ARCH), Lagrange Multiplier test for Serial correlation
3. *** significant at 1 % level; **significant at 5 % level; * significant at 10 % level

Conclusion

The study aims to analyze the importance of ICT and human capital to economic growth in Malaysia by adopting the ARDL technique of cointegration on time series data. The findings suggest that in long run, economic growth is positively determined by capital, labour, ICT and human capital. Thus, policies enhancing human capital and ICT development are important for long-run economic growth of the country.

References

- [1] S. Asongu and S.L. Roux, *Enhancing ICT for Inclusive Human Development in Sub-Saharan Africa, AGDI Working Paper, No. WP/16/029, 2016.*
- [2] R. J. Barro, *Economic Growth in Cross-section of Countries. Quarterly Journal of Economics 106 (1991), 407-444.*
- [3] A.M. Elsadiq, *ICT and Human Capital Intensities Effect on Malaysian Productivity Growth, International Research Journal of Finance and Economics 13 (2008), 152- 161.*
- [4] A. M. Elsadiq, *Assessing The Impact Of ICT and Human Capital Impact on Productivity of ASEAN-5 Economies, Journal Of Global Management 1(1) (2011), 23-35.*
- [5] A. A. Erumban and D.K. Das, *Information and Communication Technology and Economic Growth in India, Telecommunications Policy 40(5) (2016), 412-431*
- [6] S. Jin and C.M. Cho, *Is ICT A New Essential for National Economic Growth in An Information Society?, Government Information Quarterly 32 (2015), 253–260*
- [7] D.W. Jorgenson and K.M. Vu, *The ICT Revolution, World Economic Growth and Policy Issues, Telecommunications Policy 40(5) (2016), 383-397*
- [8] M. Kuppasamy and B. Shanmugam, *Information Communication Technology and Economic Growth in Malaysia, Review of Islamic Economics 11(2) (2007), 87-100.*

Submit Date: 10.07.2018, Acceptance Date: 22.08.2018, DOI NO: 10.7456/1080SSE/189

Research Article - This article was checked by Turnitin

Copyright © The Turkish Online Journal of Design, Art and Communication

- [9] R.E. Lucas, Jr., *On the Mechanics of Economic Development*, *Journal of Monetary Economics* 22 (1988), 3-42.
- [10] P.K. Narayan, *Reforming Critical Values for the Bounds F-Statistics Approach to Cointegration: An Application to the Tourism Demand for Fiji*, *Discussion Papers, Department of Economics, Monash University, Australia*, 2004.
- [11] A. Norhanani, *An Analysis of Human Capital and Economic Growth in The Case of Malaysia: 1970-2008*, *Unpublished master theses, International Islamic University Malaysia, Kuala Lumpur*, 2010
- [12] M. Pesaran, Y. Shin and R. Smith, *Bounds Testing Approaches to the Analysis of Level Relationships*, *Journal of Applied Econometrics* 16(3) (2001), 289-326.
- [13] P.M. Romer, *Increasing Returns and Long-Run Growth*, *Journal of Political Economy* 94 (1986), 2-37.
- [14] A.C.Teixeira and F. Natercia, *Human capital, Innovation Capability and Economic Growth in Portugal, 1960-200*, *Portuguese Economic Journal* 3(3) (2004), 205-225.