Asian Academy of Management Journal, Vol. 27, No. 2, 1–20, 2022

THE ROLES OF ICT TELECOMMUNICATION INFRASTRUCTURE ON FOREIGN DIRECT INVESTMENT IN MALAYSIA

Kui Ming Tiong[1*], Ming Yu Cheng[1], and Chee Keong Choong[2]

[1]Universiti Tunku Abdul Rahman, Faculty of Accountancy and Management, Sungai Long Campus, Jalan Sungai Long, Bandar Sungai Long, 43000 Kajang, Selangor, Malaysia
[2]Universiti Tunku Abdul Rahman, Faculty of Business and Finance, Kampar Campus, Jalan Universiti, Bandar Barat, 31900 Kampar, Perak, Malaysia

*Corresponding author: tiongkm@utar.edu.my

Published online: 7 December 2022

To cite this article: Tiong, K. M., Cheng, M. Y., & Choong, C. K. (2022). The roles of ICT telecommunication infrastructure on foreign direct investment in Malaysia. *Asian Academy of Management Journal*, *27*(2), 1–20. https://doi.org/10.21315/aamj2022.27.2.1

To link to this article: https://doi.org/10.21315/aamj2022.27.2.1

ABSTRACT

The development of the digital economy and the emergence of new technologies are changing the way of doing business. In recent foreign direct investment (FDI) studies, factors in addition to conventional ownership-location-internalisation (OLI) factors have been explored to enrich the FDI model. This study looks at the roles of information and communications technology (ICT) telecommunication infrastructure on FDI in Malaysia. The two-step system generalised method of moments (GMM) approach is used. To overcome the limitations of the dynamic panel model on the "small groups" problem, this study uses five three-year average data for the period between 2002 to 2016, and the Windmeijer finite-sample correction, the robust standard errors for estimation. The results show a significant positive role of mobile telephony on FDI. Besides, institutional factors are found to have significant impacts on FDI. The findings indicate the importance of the institutional framework and ICT telecommunication infrastructure, which can be jointly used with the OLI paradigm to explain factors driving FDI in the new economy.

Keywords: ICT telecommunication infrastructure, digital economy, Internet, mobile telephone, fixed broadband

© Asian Academy of Management and Penerbit Universiti Sains Malaysia, 2022. This work is licensed under the terms of the Creative Commons Attribution (CC BY) (http://creativecommons.org/licenses/by/4.0/).

INTRODUCTION

Information and communications technology (ICT) has proven to be the key technology (OECD, 2004) and the important driver of growth (Kuppusamy et al., 2009; Sassi & Goaied, 2013; Latif et al., 2018) and foreign direct investment (FDI) (Xaypanya et al., 2015; Asongu et al., 2018). In particular, developing countries with better telecommunications networks received greater FDI inflows (Lydon & Williams, 2005). In Malaysia, the launching of the Multimedia Super Corridor (MSC) in 1996 marked the major milestone in ICT development in the country. The MSC propels the transformation of the economy into a knowledge-based and ICT driven. Since then, the ICT sector plays an important role in the Malaysian economy, where Malaysia is one of the world's top 10 exporters of ICT goods (United Nations Conference on Trade and Development [UNCTAD], 2019). The ICT sector contributed to 19.1% of the country's gross domestic product (GDP) in 2019 (Department of Statistics Malaysia Official [DOSM], 2020a).

While the global economy is transforming into a more digitalised economy, the key phenomenon of the digital economy is the increasing use of the Internet to facilitate communications. ICT telecommunication tools such as fixed telephones, mobile telephones, the Internet, and broadband are becoming important device to enable communications. This is witnessed by an increasing global trend of ICT telecommunication development over the past two decades. As a result of continuous efforts provided by the Malaysian government to develop and promote ICT development, Internet usage has been growing in Malaysia. Malaysia was ranked at 31st position in the overall Network Readiness Index (NRI) in 2016. In particular, with approximately two-thirds of the population online; individual usage ranked 47th, and business usage ranked 26th (World Economic Forum [WEF], 2016). The internet usage has continued to grow from 81.2% in 2018 to 84.2% in 2019 (DOSM, 2020b). Besides, in terms of e-commerce readiness, according to the business to consumer (B2C) e-commerce index, Malaysia was ranked fifth among the top 10 developing economies in Asia for readiness to support online shopping (UNCTAD, 2018).

The digital economy is changing the traditional determinants of FDI and investment drivers (UNCTAD, 2020). In the past studies, the impacts of telecommunication infrastructure on FDI often measured in terms of the fixed telephone (Naudé & Krugell, 2007; Williams, 2015; Masron, 2017). However, the use of fixed telephone does not adequately address the importance of different telecommunication tools on FDI in the digital economy. In light of recent digital development, in addition to conventional factors in explaining FDI, other factors should be considered due to the emergence of new technologies that change the way of doing business, which may facilitate and promote FDI. Hence, it is important to understand the relevant elements in attracting FDI in Malaysia. This study aims to examine the role of ICT telecommunication infrastructure on FDI in Malaysia.

Using the two-step system generalised method of moments (GMM) approach, to overcome the limitation of the dynamic panel model of "small groups" as in the present study, this paper chooses to use five three-year average periods from 2002 to 2016. Besides, the Windmeijer (2005) finite-sample correction, the robust standard errors are used for estimation, and only two lags are used for instruments in estimation (Roodman, 2009). The findings are confirmed by robustness checks using additional variable and annual data from 2002 to 2016. The robust results provide insight into the importance of the institutional factors to complement the OLI paradigm and suggest policies to expand and upgrade ICT telecommunication infrastructure for quality data connections to improve the regulatory framework on data protection and security, and promote ICT adoption for businesses.

LITERATURE REVIEW

This study revisits the eclectic paradigm or the OLI paradigm (Dunning, 1980) to examine the role of ICT telecommunication infrastructure on FDI in Malaysia. The second pillar of the OLI paradigm, the location-specific advantages, has been widely used as the theoretical framework for FDI studies (Cuyvers et al., 2011; Tahir & Chen, 2011; Kang & Jiang, 2012; Saini & Singhania, 2018). The location-specific advantages identified four motives of multinational enterprises (MNEs) to invest abroad; market-seeking, resource-seeking, efficiency-seeking, and strategic asset-seeking motives, or generally regarded as the traditional economic factors (Kang & Jiang, 2012).

FDI and Location-Specific Advantages

Among the four motives of the location-specific advantages, the resource seeking pillar consists of natural resources, infrastructure, investment incentives, and others. Infrastructure can be broadly classified into two groups. The first group of studies measures infrastructure in terms of transportation (Loree & Guisinger, 1995; Wong, 2005), while the second group of studies measures infrastructure in terms of telecommunication (Lydon & Williams, 2005; Naudé & Krugell, 2007; Shah, 2014; Williams, 2015). Salem and Baum (2016) also measured infrastructure in terms of transportation and telecommunication as the overall infrastructure quality. Transportation infrastructure is essential in facilitating the flows of tangible goods. However, in the digital economy, it involves both the flows of tangible goods and the flows of intangible data and information. Hence, ICT telecommunication infrastructure plays an essential role in the digital economy.

The importance of ICT telecommunication has been addressed in various studies (Choi, 2003; Gani & Sharma, 2003; Gholami et al., 2005). In the study of Gani and Sharma (2003), ICT and the diffusion of new ICT tools such as mobile phones and Internet hosts have significantly attracted FDI inflows. Furthermore, Choi (2003) has shown a positive relationship between the growth of Internet users and FDI inflows, and the growth of Internet hosts and FDI inflows. The use of the Internet could reduce the searching cost for business to business (B2B), B2C as well as business to government (B2G). Lower cost is therefore, leading to higher productivity and thus promoting FDI inflows. In developed countries, ICTs found positively related to FDI inflows, while in developing countries, no significant results found between ICT and FDI inflows (Gholami et al., 2005). Therefore, in addition to fixed telephony, the Internet, mobile applications, and broadband networks are the parts and foundations of the digital economy; all these are potential factors to be considered.

Besides, market-seeking, efficiency-seeking, and strategic asset-seeking have been important for multinational enterprises' motives to invest abroad. The market-seeking pillar such as market growth, the higher the economic growth rates in the host country, the more FDI inflows (Ang, 2008; Williams, 2015). While the efficiency-seeking pillar, macroeconomic stability in the host country is important to attract FDI. A low inflation rate indicates a more stable economic environment, therefore higher FDI inflows (Mugableh, 2015; Williams, 2015). The strategic asset-seeking pillar, for instance, technology has been an important strategic asset. Often foreign firms invest abroad to acquire such technology or skills in the host country. The higher the level of technology, the more FDI inflows (Athukorala & Waglé, 2011; Buckley et al., 2012).

FDI and Institutions

Due to increasing globalisation and interdependence among countries, international integration and cooperation have gained strong momentum and attention (Suthiphand et al., 1999). Given the increasing importance of the institutional factors in international economic activities including FDI, Dunning and Lundan (2008) have incorporated institutional elements into the OLI paradigm. According to Scott (1995), there are three pillars to explain institutional environment: regulative, normative, and cognitive. The regulative pillar of the institutional environment resembles the "rules of the game" that structure the interactions and ensure stability and order in societies (North, 1990), including laws, rules and regulations, and policies that govern the economy. For instance, economic freedom has been a significant factor for FDI (Kang & Jiang, 2012; Economou, 2019). Besides, the cognitive pillar of the institutional environment addresses the importance of cultural distance (CD). The larger the CD between the host and home countries, the more challenge it is for MNEs to gain normative legitimacy in the host country. Cultural differences between the two economies have been a barrier for MNEs from developing countries (Kandogan, 2016). The cognitive pillar, such as home-host linkages are important determinants of FDI. Bilateral trade (BT) between the two economies has been an important factor in attracting FDI (Cuyvers et al., 2011; Kang & Jiang, 2012).

Hence, drawing on the OLI paradigm and the three pillars of the institutions, in addition to the ICT telecommunication infrastructure, this study considers the impact of market growth, macroeconomic stability, technology, institutional distance, CD, and trade linkages on FDI.

METHODOLOGY

Model and Variables Description

Most FDI studies in Malaysia have been conducted using aggregate FDI flows (Wong, 2005; Ang, 2008; Mugableh, 2015). To examine the country-pair characteristics, such as the institutional distance, CD, and BT between the two economies, this requires a bilateral FDI analysis. Using the bilateral FDI, the extended location model is explained as follows:

$$InFDI_{ijt} = \beta_0 + \beta_1 InFDI_{ijt-1} + \beta_2 InMTS_{ijt} + \beta_3 InITI_{ijt} + \beta_4 GDPG_{ijt} + \beta_5 INF_{ijt} + \beta_6 InPT_{ijt} + \beta_7 InEFI_{ijt} + \beta_8 CD_{ijt} + \beta_9 InBT_{ijt} + \beta_{10} REGIONAL_{it} + \beta_{11} TIME_t + \varepsilon_{ijt} \quad (1)$$

Where:

FDI_{ijt} = real bilateral FDI flows (US$) from home to Malaysia

MTS_{ijt} = relative mobile telephone subscriptions of Malaysia to home

ITI_{ijt} = relative ICT telecommunication infrastructure of Malaysia to home

$GDPG_{ijt}$ = difference between the real GDP growth rate of Malaysia and home

INF_{ijt} = difference between the real inflation rate of Malaysia and home

PT_{ijt} = difference between the yearly patents registered in Malaysia and home

EFI_{ijt} = difference between the economic freedom index of Malaysia and home

CD_{ijt} = CD between Malaysia and home

BT_{ijt} = BT between home and Malaysia

$REGIONAL_{it}$ = dummy equals 1 for economies in the Asia-Pacific region, 0 otherwise

$TIME_t$ = dummy equals to 1 for period 2002–2004, 2005–2007, 2008–2010, 2011–2013, and 2014–2016 respectively, 0 otherwise

Foreign direct investment

FDI is measured using annual approved real bilateral FDI flows in Malaysia's manufacturing investment. Data were obtained from Malaysian Investment Development Authority (MIDA). Bilateral FDI statistics were first converted into millions of US dollars based on the period average of the official exchange rate (local currency per US$) and then converted into the real bilateral FDI using the GDP deflator (2010). Both statistics were obtained from World Development Indicators (WDI) of the World Bank.

ICT telecommunication infrastructure

While fixed telephone, mobile telephone, Internet user, fixed broadband, and Internet servers have been used to measure the telecommunication infrastructure for Asian (Pradhan et al., 2017). However, due to the limited availability of data for Internet servers, followed the publication of the International Telecommunication Union (ITU), the ICT telecommunication infrastructure is measured using mobile telephone subscriptions (MTS), and ICT telecommunication infrastructure (ITI). ITI is the average value of fixed broadband subscription (FBS), Internet user, and fixed telephone subscription (FTS) computed based on the principal component analysis (PCA). Data were collected from the ITU.

Market growth

Market growth is measured using real gross domestic product growth (GDPG). Besides, the market potential is measured using the real GDP. GDP is used for robustness checks. Data were collected from World Bank's WDI and Taiwan Statistical Data Book 2007 and 2016.

Macroeconomic stability

Macroeconomic stability is measured using the real inflation rate (INF) (GDP deflator). This is because a high inflation rate often reflects macroeconomic instability and resulted in potential risk for foreign investors. Data were collected from World Bank's WDI and Taiwan Statistical Data Book 2007 and 2016.

Technology

Malaysia has realised the importance of technology and has begun to invest in building technological capacity and promoting innovation activities. The outcomes of such innovation activities are often measured in terms of patents, licensing, and royalties (Chandran et al., 2009). Therefore, technology differences are measured in terms of the number of yearly patents registered by residents (PT). Data were collected from World Bank's WDI, Taiwan Statistical Data Book 2007 and 2016, and the Taiwan Intellectual Property Office (TIPO).

Institutional distance

Economic freedom is essential for doing business. As an institutional-regulative factor, a higher level of economic freedom in the host country can attract more FDI inflows (Pearson et al., 2012). Hence, the economic freedom of both home and host economies is important for bilateral FDI. Economic freedom indices, such as business freedom, financial freedom, freedom from corruption, monetary freedom, and property right are key factors that contributed to market efficiency (Kang & Jiang, 2012). In this study, institutional distance is measured using the composite economic freedom index (EFI). The EFI is computed by averaging the scores of the five indices, business freedom, financial freedom, freedom from corruption, monetary freedom, and property right. Data were collected from Economic Freedom Index, Heritage Foundation.

Cultural distance

According to Ghemawat (2001), CD is measured in terms of religion, culture, and language. CD has been widely used in past studies (Kogut & Singh, 1988; Kang & Jiang, 2012) therefore selected for this study. CD indices were obtained from the original four cultural dimensions of Hofstede study and computed using the method developed by Kogut and Singh (1988).

Trade linkages

Trade linkages between the two economies are measured using the BT value between the two economies (Buckley et al., 2012, Kang & Jiang, 2012). Data were obtained from the Organisation for Economic Co-operation and Development (OECD).

Dummy variables

Regional (REGIONAL) and time (TIME) are included. REGIONAL dummy is introduced to capture the unequal ICT development across the Asia-Pacific region. Dummy 1 is for economies in the Asia-Pacific region, 0 otherwise. TIME dummies are coded for five periods (2002–2004, 2005–2007, 2008–2010, 2011–2013, and 2014–2016).

Sample

Considering the key digital milestones and the availability of bilateral FDI data, the study uses the period 2002 to 2016 for analysis. These key digital milestones are: the adoption of the Millennium Development Goals (MDGs) in 2000 that addressed the vital role of ICT, digital information storage surpassed non-digital storage in 2002, the adoption of the third generation of access technology (3G) worldwide, and the launch of Taobao, an e-commerce platform in 2003, the launch of social media platform, Facebook in 2004 as well as YouTube in 2005, and subsequently leading to the increasing popularity of ICT, Internet user worldwide have reached 2 billion people in 2014.

The availability of bilateral FDI statistics is limited. This study uses data provided by MIDA, the government agency. The data of approved FDI is selected because it represents the bilateral inflows that were actualised, and no reverse flows were recorded in this case. Based on data availability, a panel of the top 20 economies in terms of the total number of approved manufacturing investment in Malaysia for the period 2000 to 2016 is selected. The British Virgin Island is excluded in this study due to the limited availability of data for such island, especially for CD indices and replaced by Denmark. These economies are Australia, China, Hong Kong, India, Indonesia, Japan, South Korea, Singapore, Taiwan, and Thailand from Asia-Pacific; Denmark, France, Germany, Italy, Netherlands, Sweden, Switzerland, and the United Kingdom from Europe, and Canada and the United States from America. However, to deal with the dynamic panel model of "small" groups as in the present study, this paper chooses to use five three-year average periods for estimation, a period of 2002 to 2016 is therefore selected.

Analytical Approach

In the dynamic panel model, a linear regression model is generalised by incorporating the lagged dependent variable:

$$y_{it} = \alpha y_{i,t-1} + \beta' X_{it} + \lambda_i + \mathcal{E}_{it} \qquad (2)$$

Where $i = 1, \ldots, N$, and $t = 2, \ldots, T$, x_{it} represents the set of K regressors, λ_i is the unobserved time-invariant individual effect, ε_{it} is the independent and identically distributed disturbance. A fundamental assumption of regression analysis is that the independent variables are uncorrelated with the error term. However, FDI is a dynamic process. To see whether FDI inflows are correlated with past observations, the lagged FDI is included as an independent variable. Now the lagged dependent variable, $y_{i,t-1}$ includes in the right-hand side variables. Thus, the model is complicated by the correlation between the lagged dependent variable and the disturbance. The ordinary least squares (OLS) therefore are biased and inconsistent in estimation. There is a need to go for dynamic estimation.

For dynamic estimation, the GMM method is increasingly popular. These GMM estimators are based on (i) the Arellano-Bond, the difference GMM, and (ii) Arellano and Bover, and Blundell and Bond, the system GMM. Both difference and system GMM estimators are generally designed for situations with "small T" and "large N" panels, and when independent variables are correlated with the error term, and fixed effects (Roodman, 2009).

In considering between difference and system GMM, system GMM is selected for analysis. This is because concerning the institutional time-invariant variable, CD. The difference GMM eliminates the effect of the time-invariant variable in the first difference, thus difference GMM is inappropriate. However, system GMM combines level and difference equations in the estimation, the lagged differences of the regressors are then used as additional instruments for a level equation for estimation. The two-step system GMM uses optimal weighting matrices for estimation, and it is more efficient than the one-step estimation in this case. This study opts to use a two-step system GMM for estimation.

When using two-step GMM, a few issues to be addressed. Given the "small" groups as in the present study, two-step GMM may lead to biased GMM standard errors and the problem of too many instruments. First, to eliminate such biased GMM standard errors, Windmeijer's (2005) finite-sample correction for standard errors, the robust standard errors are used to address the potential downward bias of the two-step measurement for small-sample. Second, the problem of too many instruments, in the situation of small groups, the number of instruments may exceed the number of groups, and often leading to a perfect p-value of 1.00 found in the overidentification restrictions (OIR) test. This is the classic sign of instrument proliferation (Roodman, 2009), and commonly found in some studies.

To deal with the dynamic panel model of small groups, first, this paper chooses to use five three-year average periods (2002–2004, 2005–2007, 2008–2010, 2011–2013, and 2014–2016) for estimation. There is no consensus on the determination of the appropriate time intervals (Temple, 1999). As compared to five-year averages, the use of three-year averages allows to keep a sufficient number of observations to be used for the time dimension (Bonnefond, 2014). Second, a full set of time dummies is also included. This allows to control the time-specific effects as fixed and to remove global time-related shocks from the errors, such as the financial crisis 2008–2009 as present in this study. The REGIONAL dummy is introduced to capture the unequal ICT development across the Asia-Pacific region. A full set of TIME dummies is introduced for the five-period intervals (2002–2004, 2005–2007, 2008–2010, 2011–2013, and 2014–2016).

Using the two-step system GMM, the extended location model is measured in levels, while the lagged difference of the predetermined variables measured as additional instruments. To address the issue of too many instruments, in the situation of "small N" ($N = 20$) as present in this study, followed Roodman (2009), this paper uses only two lags for instruments in estimation. By taking the natural logarithms transformation for both the dependent and independent variables, excluding variables expressed in percentage (GDPG, INF), and time-invariant indices (CD), the results of the log-log linear model are discussed as follows.

RESULTS AND DISCUSSION

Table 1 shows the descriptive statistics of variables for the period 2002 to 2016 while Table 2 displays the correlation matrix of all independent variables. In Table 1, the mean value of approved real bilateral FDI (lnFDI) is 4.32%. The mean value of relative MTS (lnMTS), and relative ITI (lnITI) is 0.06% and –0.31%, respectively. This suggests that on average Malaysia's MTS are 0.06% more than that of the home economies, while Malaysia's ITI is 0.31% less than that of the home economies. Similar interpretations can be given for the relative GDP (LGDP), on average Malaysia's GDP is 1.56% more than that of the home economies. For GDP growth (GDPG) and inflation rate (INF), on average the difference between the real GDPG, and the real INF of Malaysia and home economies is 2.22% and 1.42%, respectively. The mean value of technology differences, patents (lnPT), and institutional distance, EFI (lnEFI) between Malaysia and home economies is around 9.01% and 3.05%, respectively. On average, the CD between Malaysia and home economies is 2.61. The mean value of BT (lnBT) between home and Malaysia is 8.87%.

Table 1
Descriptive statistics of variables

	Mean	Maximum	Minimum	Standard deviation
lnFDI	4.32	8.30	–6.91	2.30
lnMTS	0.06	3.45	–1.08	0.55
lnITI	–0.31	2.39	–1.07	0.81
GDPG	2.22	9.82	–14.21	3.78
lnGDP	1.56	1.74	1.48	0.07
INF	1.42	14.60	–13.29	4.42
lnPT	9.01	14.00	2.40	2.39
lnEFI	3.05	3.70	1.39	0.48
CD	2.61	5.28	0.40	1.49
lnBT	8.87	11.57	–6.91	1.68

Table 2
Correlation matrix of independent variables

	$\ln FDI_{t-1}$	lnMTS	lnITI	GDPG	lnGDP	INF	lnPT	lnEFI	CD	lnBT	REGIONAL
$\ln FDI_{t-1}$	1.00										
lnMTS	–0.07	1.00									
lnITI	–0.21	0.65	1.00								
GDPG	–0.03	–0.55	–0.59	1.00							
lnGDP	–0.16	–0.42	–0.06	–0.07	1.00						
INF	0.18	–0.53	–0.68	0.39	0.06	1.00					
lnPT	0.39	0.18	–0.26	0.06	–0.72	0.22	1.00				
lnEFI	0.05	–0.18	–0.38	0.01	0.11	0.13	–0.07	1.00			
CD	–0.05	–0.27	–0.63	0.69	–0.24	0.40	0.24	0.28	1.00		
lnBT	0.67	0.17	0.17	–0.40	–0.13	–0.10	0.25	–0.13	–0.52	1.00	
REGIONAL	0.24	0.19	0.47	–0.57	0.29	–0.25	–0.17	–0.25	–0.71	0.56	1.00

Robustness Checks

The dataset is split into two for estimation purposes. The first data set uses five three-year averages data (2002–2004; 2005–2007; 2008–2010; 2011–2013; 2014–2016) for estimation, and the second data set uses annual data from 2002 to 2016 for robustness checks (Appendix 1). Two diagnostics tests are performed to check the validity of the instruments and the autocorrelation. In Table 3, Model 1(a), the Sargan test of OIR shown that the instruments are valid and no second-order autocorrelation, AR(2). This suggests that Model 1(a) is correctly specified with the *p*-value of OIR and AR(2) above 0.05. However, for the two-step system GMM estimation, the Windmeijer (2005) finite-sample correction for standard errors, the robust standard errors are recommended to overcome the two-step potential downward bias measurement for small sample standard error correction.

To benchmark the results, two robustness checks were performed using both the GMM standard errors and robust standard errors for estimation. The first robustness checks with the inclusion of additional variable, market size, the real GDP, while the second robustness checks using the annual data from 2002 to 2016. In Appendix 1, it is clear that the inclusion of an additional variable, GDP is not significant. And the overall results using the annual data from 2002 to 2016 are consistent with the results of Model 1(b) in Table 3. However, the *p*-value of the OIR is 0.99. There exists a problem with too many instruments. Therefore, this study discusses the robust findings of Model 1(b) as follows.

In Table 3, Model 1(b) suggests that the bilateral FDI inflows are significant and correlated with the past bilateral FDI, the coefficient for bilateral FDI, at the first lag is negative. This means that when bilateral FDI increases by 1%, bilateral FDI reduces by 0.62% during the first lag.

Table 3
Two-step system GMM, three-year averages

	GMM standard errors Model 1(a)	Robust standard errors Model 1(b)
$\ln FDI_{t-1}$	-0.62^{***} (0.21)	-0.62^{**} (0.25)
lnMTS	1.39^{***} (0.37)	1.39^{***} (0.50)
lnITI	1.30 (0.93)	1.30 (1.20)
GDPG	0.19^{*} (0.11)	0.19 (0.13)
INF	0.12 (0.10)	0.12 (0.14)
lnPT	0.28 (0.25)	0.28 (0.27)
lnEFI	1.80^{**} (0.72)	1.80^{**} (0.77)
CD	–4.38 (2.95)	–4.38 (7.68)
lnBT	0.74^{***} (0.10)	0.74^{***} (0.11)
REGIONAL	–22.00 (16.74)	–22.00 (39.96)
PERIOD 2005–2007	18.13 (17.81)	18.13 (44.96)
PERIOD 2008–2010	18.68 (17.76)	18.68 (44.90)

(continued on next page)

Table 3: (*continued*)

	GMM standard errors Model 1(a)	Robust standard errors Model 1(b)
PERIOD 2011–2013	18.38 (17.97)	18.38 (45.22)
PERIOD 2014–2016	18.61 (18.02)	18.61 (45.28)
Number of observations	80	80
Number of groups	20	20
Number of instruments	18	18
Sargan Test (OIR) (*p*-value)	0.37	–
AR(2) (*p*-value)	0.33	0.53

Notes: *, **, *** denotes the significance level of 90%, 95%, and 99%, respectively; standard error (SE) in parentheses; Model 1(a) reports GMM standard errors; Model 1(b) reports robust standard errors (Windmeijer, 2005)

MTS is significant in attracting bilateral FDI inflows to Malaysia. The estimated coefficient of MTS is significant and positive. This suggests that a higher MTS of Malaysia to home tends to motivate home to invest in Malaysia. A 1% increase in the relative MTS of Malaysia to home induces a 1.39% increase in bilateral FDI inflows. However, the composite ITI of FBS, Internet user, and FTS is not significant. Realising the importance of ITI, there is a need for the government to expand and upgrade the telecommunication network coverage in Malaysia to boost internet usage. However, GDPG, INF, and PT are insignificant. These findings are consistent with past studies. According to Karimi and Yusof (2009), no long-run relationship between economic growth and FDI was found in Malaysia. Also, no long-run relationship between inflation rate and FDI was found in Malaysia (Shahrudin et al., 2010). While for technology, often, it is the opposite role, FDI was found to have positive technology spill over effects in Malaysia (Masron et al., 2012; Yunus et al., 2015).

Besides, institutional distance and BT are significant factors for FDI. Institutional distance, economic freedom index (EFI), the estimated coefficient is significant and positive. This implies that home economies tend to invest in a more institutional distant country. Trade linkages, the estimated coefficient of BT between home and Malaysia is significant and positive. This implies that the greater intensity of BT between home and Malaysia tends to increase bilateral FDI inflows. A 1% increase in the BT between home and Malaysia induce 0.74% of bilateral FDI inflows to Malaysia. However, CD is insignificant. Similarly, Kang and Jiang (2012) also showed insignificant results based on the FDI study in East and Southeast Asia.

CONCLUSION AND POLICY IMPLICATIONS

In light of recent digital development, in addition to conventional factors in explaining FDI, other factors should be considered due to the emergence of new technologies that change the way of doing business, which may facilitate and promote FDI. This study examined the role of ITI on FDI in Malaysia. Using the two-step system GMM approach, to overcome the limitation of the dynamic panel model of "small" groups, the five three-year average periods from 2002 to 2016 were chosen for analysis. Also, the Windmeijer (2005) finite-sample correction, the robust standard errors were used for estimation. The robust results show a significant positive role of mobile telephony on FDI and a significant role of institutional factors on FDI.

The significant role of mobile telephony reflects the importance of ITI on FDI. There is a need to upgrade and enhance the ITI in Malaysia to promote greater use of ICT in the digital economy. The government is playing an active role in building the digital government. Efforts have been made to improve the quality of government services through the implementation of MyGovernment portal as a digital gateway to all government online services. Online services have been provided to facilitate FDI by reducing the time for license approval. In the Eleventh Malaysia Plan Economic Planing Unit (EPU) (2016–2020), the government is committed to expanding and enhancing the digital infrastructure. A greater emphasis is placed on the affordability and efficiency of digital services, and greater coverage and connectivity is promoted by providing broadband infrastructure in rural areas (EPU, 2015). According to the Malaysian Institute of Economic Research (MIER) report, the implementation of 5G mobile technology is predicted to contribute up to RM12.7 billion between 2021 and 2025 to the Malaysian economy. This would also create more than 39,000 new job opportunities (Malaysian Communications and Multimedia Commission [MCMC], 2020). However, the 5G network system has raised important concerns on its security and privacy issues. Several security challenges remain such as transparency, network privacy and vulnerabilities, and others (Nguyen et al., 2020; Sicari et al., 2020). Therefore, there is a need to formulate appropriate policies to expand and upgrade ITI for quality data connections and to improve the regulatory framework on data protection, security and privacy, and consumer protections to protect individual users from cybercrime. Besides, the findings provide important managerial implication. Firms are encouraged to be early adopters of ICT for businesses. As an early adopter, firms could play a significant role in the digital economy and therefore benefited (World Bank, 2006). Realising the importance of digital transformation, firms should adopt digital technologies for the new business model while entering into the digital future to remain competitive.

The robust findings provide insight into the importance of the institutional framework that can be jointly used with the OLI paradigm to understand better factors driving FDI. However, this study is limited to the use of ITI at macro-level analysis. Based on the proposed framework, comprehensive studies to incorporate other ICT tools to address the importance of ICT on FDI as well as the importance of ICT on the digital economy, such as the recent pandemic of coronavirus, are recommended.

REFERENCES

Ang, J. B. (2008). Determinants of foreign direct investment in Malaysia. *Journal of Policy Modeling*, *30*(1), 185–189. https://doi.org/10.1016/j.jpolmod.2007.06.014

Asongu, S., Akpan, U. S., & Isihak, S. R. (2018). Determinants of foreign direct investment in fast-growing economies: Evidence from the BRICS and MINT countries. *Financial Innovation*, *4*(26). https://doi.org/10.1186/s40854-018-0114-0

Athukorala, P., & Waglé, S. (2011). Foreign direct investment in Southeast Asia: Is Malaysia falling behind? *ASEAN Economic Bulletin*, *28*(2), 115–33. https://doi.org/10.1355/ae28-2b

Bonnefond, C. (2014). Growth dynamics and conditional convergence among Chinese provinces: A panel data investigating using system GMM estimator. *Journal of Economic Development*, *39*(4), 1–25. https://doi.org/10.35866/caujed.2014.39.4.001

Buckley, P. J., Forsans, N., & Munjal, S. (2012). Host–home country linkages and host–home country specific advantages as determinants of foreign acquisitions by Indian firms. *International Business Review*, *21*(5), 878–890. https://doi.org/10.1016/j.ibusrev.2011.10.001

Chandran, V. G. R., Rasiah, R., & Wad, P. (2009). Malaysian manufacturing systems of innovation and internationalisation of R&D. *Centre for Business and Development Studies*. CBDS Working Paper Series, Working Paper Number 11, Denmark.

Choi, C. (2003). Does the Internet stimulate inward foreign direct investment? *Journal of Policy Modeling*, *25*(4), 319–326. https://doi.org/10.1016/S0161-8938(02)00202-8

Cuyvers, L., Soeng, R., Plasmans, J., & Van Den Bulcke, D. (2011). Determinants of foreign direct investment in Cambodia. *Journal of Asian Economics*, *22*(3), 222–234. https://doi.org/10.1016/j.asieco.2011.02.002

DOSM. (2020a). *Information technology and communications satellite account 2019*. Department of Statistics, Malaysia.

DOSM. (2020b). *ICT use and access by individuals and households survey report 2019*. Department of Statistics, Malaysia.

Dunning, J. H. (1980). Towards an eclectic theory of international production: Some empirical tests. *Journal of International Business Studies*, *11*(1), 9–31. https://doi.org/10.1057/palgrave.jibs.8490593

Dunning, J. H., & Lundan, S. M. (2008). Institutions and the OLI paradigm of the multinational enterprise. *Asia Pacific Journal of Management*, *25*(4), 573–593. https://doi.org/10.1007/s10490-007-9074-z

Economou, F. (2019). Economic freedom and asymmetric crisis effects on FDI inflows: The case of four South European economies. *Research in International Business and Finance*, *49*, 114–126. https://doi.org/10.1016/j.ribaf.2019.02.011

Economic Planning Unit (EPU). (2015). *Eleventh Malaysia Plan 2016–2020*. Economic Planning Unit.

Gani, A., & Sharma, B. (2003). The effects of information technology achievement and diffusion on foreign direct investment. *Perspectives on Global Development and Technology*, *2*(2), 161–178. https://doi.org/10.1163/156915003322763548

Ghemawat, P. (2001). Distance still matters: The hard reality of global expansion. *Harvard Business Review*, *79*(8), 137–147.

Gholami, R., Lee, S. T., & Heshmati, A. (2005). The causal relationship between ICT and FDI. *UNU-WIDER*. Research Paper *2005/026*, Helsinki.

Kandogan, Y. (2016). Economic development, cultural differences and FDI. *Applied Economics*, *48*(17), 1545–1559. https://doi.org/10.1080/00036846.2015.1102847

Kang, Y. F., & Jiang, F. M. (2012). FDI location choice of Chinese multinationals in East and Southeast Asia: Traditional economic factors and institutional perspective. *Journal of World Business*, *47*(1), 45–53. https://doi.org/10.1016/j.jwb.2010.10.019

Karimi, M., & Yusop, Z. (2009). FDI and economic growth in Malaysia. *MPRA*, Paper No. 14999.

Kogut, B., & Singh, H. (1988). The effect of national culture on the choice of entry mode. *Journal of International Business Studies*, *19*(3), 411–432. https://doi.org/10.1057/palgrave.jibs.8490394

Kuppusamy, M., Murali, R., & Geoffrey, L. (2009). Whose ICT investment matters to economic growth: Private or public? The Malaysian perspective. *Electronic Journal of Information Systems in Developing Countries*, *37*(1), 1–19. https://doi.org/10.1002/j.1681-4835.2009.tb00262.x

Latif, Z., Mengke, Y., Danish, S. L., Ximei, L., Pathan, Z. H., Salam, S., & Jianqiu, Z. (2018). The dynamics of ICT, foreign direct investment, globalization and economic growth: Panel estimation robust to heterogeneity and cross-sectional dependence. *Telematics and Informatics*, *35*(2), 318–328. https://doi.org/10.1016/j.tele.2017.12.006

Loree, D. W., & Guisinger, S. E. (1995). Policy and non-policy determinants of U.S. equity foreign direct investment. *Journal of International Business Studies*, *26*(2), 281–299. https://doi.org/10.1057/palgrave.jibs.8490174

Lydon, R., & Williams, M. (2005). Communications networks and foreign direct investment in developing countries. *Communicaitons and Strategies*, *58*(2), 43–60.

Masron, T. A. (2017). Relative institutional quality and FDI inflows in ASEAN countries. *Journal of Economic Studies*, *44*(1), 115–137. https://doi.org/10.1108/JES-04-2015-0067

Masron, T. A., Zulkafli, A. H., & Ibrahim, H. (2012). Spillover effects of FDI within manufacturing sector in Malaysia. *Procedia - Social and Behavioral Sciences*, *58*, 1204–1211. https://doi.org/10.1016/j.sbspro.2012.09.1102

MCMC. (2020). *Commercialization of 5G redefines connectivity in Malaysia*. Malaysian Communications and Multimedia Commission.

Mugableh, M. I. (2015). Time series analysis of inward foreign direct investment function in Malaysia. *Procedia - Social and Behavioral Sciences*, *172*, 679–685. https://doi.org/10.1016/j.sbspro.2015.01.419

Naudé, W. A., & Krugell, W. F. (2007). Investigating geography and institutions as determinants of foreign direct investment in Africa using panel data. *Applied Economics*, *39*(10), 1223–1233. https://doi.org/10.1080/00036840600567686

Nguyen, D. C., Pathirana, P. N., Ding, M., & Seneviratne, A. (2020). Blockchain for 5G and beyond networks: A state of the art survey. *Journal of Network and Computer Applications*, *166*(102693). https://doi.org/10.1016/j.jnca.2020.102693

North, D. C. (1990). *Institutions, institutional change and economic performance.* Cambridge University Press. https://doi.org/10.1017/CBO9780511808678

OECD. (2004). *The economic impact of ICT: Measurement, evidence, and implications*. OECD. https://doi.org/10.1787/9789264026780-en

Pearson, D., Nyonna, D., & Kim, K. J. (2012). The relationship between economic freedom, state growth and foreign direct investment in US States. *International Journal of Economics and Finance*, *4*(10), 140–146. https://doi.org/10.5539/ijef.v4n10p140

Pradhan, R. P., Arvin, M. B., Nair, M., Mittal, J., & Norman, N. R. (2017). Telecommunications infrastructure and usage and the FDI–growth nexus: Evidence from Asian-21 countries. *Information Technology for Development*, *23*(2), 235–260. https://doi.org/10.1080/02681102.2016.1217822

Roodman, D. (2009). Practitioners' corner: A note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics*, *71*(1), 135–158. https://doi.org/10.1111/j.1468-0084.2008.00542.x

Saini, N., & Singhania, M. (2018). Determinants of FDI in developed and developing countries: A quantitative analysis using GMM. *Journal of Economic Studies*, *45*(2), 348–382. https://doi.org/10.1108/JES-07-2016-0138

Salem, M., & Baum, A. (2016). Determinants of foreign direct real estate investment in selected MENA countries. *Journal of Property Investment and Finance*, *34*(2), 116–142. https://doi.org/10.1108/JPIF-06-2015-0042

Sassi, S., & Goaied, M. (2013). Financial development, ICT diffusion and economic growth: Lessons from MENA region. *Telecommunications Policy*, *37*(4–5), 252–261. https://doi.org/10.1016/j.telpol.2012.12.004

Scott, W. R. (1995). *Institutions and organisations*. Sage Publishing.

Shah, M. H. (2014). The significance of infrastructure for FDI inflow in developing countries. *Journal of Life Economics*, *2*, 1−16. https://doi.org/10.15637/jlecon.37

Shahrudin, N., Yusof, Z., & Satar, N. M. (2010). Determinants of foreign direct investment in Malaysia: What matters most. *International Review of Business Research Papers*, *6*(6), 235–245.

Sicari, S., Rizzardi, A., & Coen-Porisini, A. (2020). 5G in the internet of things era: An overview on security and privacy challenges. *Computer Networks*, *179*(107345). https://doi.org/10.1016/j.comnet.2020.107345

Suthiphand, C., Chumporn, P., & Patcharawalai, W. (1999). ASEAN prospects for regional integration and the implications for the ASEAN legislative and institutional framework. *ASEAN Economic Bulletin*, *16*, 28–50.

Tahir, R., & Chen, W. (2011). Strategic motivations of Australian and New Zealand manufacturing foreign direct investments in international markets. *Asian Academy of Management Journal*, *16*(2), 131–148.

Temple, J. (1999). The new growth evidence. *Journal of Economic Literature*, *37*(1), 112–156. https://doi.org/10.1257/jel.37.1.112

UNCTAD. (2018). *World Investment Report 2018*. United Nations Publications.

UNCTAD. (2019). *Trade in electronic components drives growth in technology goods*. United Nations Publications.

UNCTAD. (2020). *World Investment Report 2020: International production beyond the pandemic*. United Nations Publications.

WEF. (2016). *The global information technology report 2016: Innovating in the digital economy*. World Economic Forum.

Williams, K. (2015). Foreign investment in Latin America and the Caribbean: An empirical analysis. *Latin American Journal of Economics*, *52*(1), 57–77.

Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*, *126*(1), 25–51. https://doi.org/10.1016/j.jeconom.2004.02.005

Wong, H. T. (2005). The determinants of foreign direct investment in the manufacturing industry of Malaysia. *Journal of Economic Cooperation*, *26*(2), 91–110.

World Bank. (2006). *Information and communications for development: Global trends and policies*. The World Bank.

Xaypanya, P., Rangkakulnuwat, P., & Paweenawat, S. W. (2015). The determinants of foreign direct investment in ASEAN: the first differencing panel data analysis. *International Journal of Social Economics*, *42*(2), 239–250. https://doi.org/10.1108/IJSE-10-2013-0238

Yunus, N. M., Said, R., & Azman-Saini, W. N. W. (2015). Spillover effects of FDI and trade on demand for skilled labour in Malaysian manufacturing industries. *Asian Academy of Management Journal*, *20*(2), 1–27.

APPENDIX

Robustness checks: Two-step system GMM

(a) Three-Year Averages Sample: Inclusion of An Additional Variable Gross Domestic Product (GDP)		
	GMM Standard Errors	Robust Standard Errors
$\ln FDI_{t-1}$	−0.67*** (0.19)	−0.67** (0.29)
lnMTS	1.39*** (0.39)	1.39** (0.55)
lnITI	1.43 (0.97)	1.43 (1.13)
GDPG	0.19* (0.11)	0.19 (0.14)
lnGDP	−6.86 (14.98)	−6.86 (18.77)
INF	0.11 (0.09)	0.11 (0.14)
lnPT	0.31 (0.26)	0.31 (0.28)
lnEFI	1.84*** (0.54)	1.84*** (0.60)
CD	−9.60 (8.07)	−9.60 (24.38)
lnBT	0.71*** (0.10)	0.71*** (0.15)
REGIONAL	−45.72 (43.95)	−45.72 (115.87)
PERIOD 2005–2007	58.13 (53.55)	58.13 (149.09)
PERIOD 2008–2010	58.74 (53.55)	58.74 (149.19)
PERIOD 2011–2013	58.45 (53.71)	58.45 (149.23)
PERIOD 2014–2016	58.73 (53.82)	58.73 (149.18)
Number of Observations	80	80
Number of Groups	20	20
Number of Instruments	19	19
Sargan Test (OIR) (*p*-value)	0.39	–
AR(1) (*p*-value)	0.02	0.16
AR(2) (*p*-value)	0.31	0.55

(b) Full Sample, Period 2002–2016		
	GMM Standard Errors	Robust Standard Errors
$\ln FDI_{t-1}$	−0.01 (0.05)	−0.01 (0.11)
lnMTS	−0.59 (0.87)	−0.59 (1.53)
lnITI	−1.84* (0.95)	−1.84 (1.88)
GDPG	0.04* (0.02)	0.04 (0.05)
INF	0.01 (0.01)	0.01 (0.03)
lnPT	0.16 (0.11)	0.16 (0.29)
lnEFI	0.39 (1.32)	0.39 (2.28)
CD	0.29 (0.90)	0.29 (1.42)
lnBT	−0.25 (0.20)	−0.25 (0.47)

(continued on next page)

(*continued*)

(b) Full Sample, Period 2002–2016		
	GMM Standard Errors	Robust Standard Errors
REGIONAL	4.16* (2.23)	4.16 (3.64)
CONSTANT	0.39 (3.91)	0.39 (7.19)
Number of Observations	280	280
Number of Groups	20	20
Number of Instruments	47	47
Sargan Test (OIR) (*p*-value)	0.99	–
AR(1) (*p*-value)	0.00	0.00
AR(2) (*p*-value)	0.06	0.17

Notes: *, **, *** denote the significance level of 90%, 95% and 99%, respectively; standard error (SE) in parentheses