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Economic Growth and Financial Development Nexus in Malaysia: Dynamic Simultaneous Equations Models

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Abstract

This paper estimates the equilibrium and causality relationships among gross domestic product, energy consumption, financial development, foreign direct investment inflows, and gross fixed capital formation. Different econometrics tests like descriptive statistics, ARCH, KPSS unit root, Johansen and Juselius's co-integration, VECM Granger causality, and ARDL equilibrium relationships have been employed in Malaysia over the (1971−2013) period. The correlation matrix results indicate a linear association among variables. The null hypotheses of Heteroscedasticity and non-stationary have been rejected implying the appropriate use of VECM and ARDL approach. The VECM Granger causality findings show a long-run bidirectional among the variables. The ARDL approach results demonstrate that energy consumption, financial development, foreign direct investment inflows, and gross fixed capital formation augment gross domestic product in long-run. However, the findings of this paper add essential implications to policy makers and scholars in fields of economic, energy, and finance.

Keywords: ARCH; ARDL, Economic Growth, VECM; Malaysia.

1. Introduction

Over the past era, several studies have been conducted to debate the relationships between gross domestic product (GDP) and its determinants. That is, numerous papers have debated the relationship between GDP and energy consumption (EC) (See Alam*et al.*,2012; Alam*et al.*,2011; Altinay & Karagol, 2004; Apergis & Payne, 2010; Asafu-Adjaye, 2000; Belloumi, 2009; Dagher & Yacoubian, 2012; Jobert & Karanfil, 2007; Lean & Smith, 2010; Menyah & Wolde-Rufael, 2010; Ozturk & Acaravci, 2010; Wang*et al.*,2011; Zhang &Cheng, 2009). The relationship between GDP and financial development (FD) has been discussed by several studies (See Abu-Bader &Abu-Qarn, 2008; Al-Yousif, 2002; Bojanic, 2012; Calderon&Liu, 2003; Campos*et al.*,2012; Chang, 2002; Christopoulos & Tsionas, 2003; Deb & Mukherjee, 2008; Hassan*et al.*,2011; Hondroyiannis*et al.*,2005; Hsueh*et al.*,2013; Kar*et al.*,2011; Lee &Chang, 2009; Liang & Teng, 2006; Shan & Jianhong, 2006; Yang & Yi, 2008; Zhang *et al.*,2012). In addition, the relationship between GDP and foreign direct investment inflows (FDI) has been argued by studies of Boutabba (2014) and Hamdi*et al.*(2014).

With regard to the research on the determinants of GDP in Malaysia, a bulk of studies have been conducted in such area (e.g., Ang, 2008a; Ang, 2008b; Ang & Mckibbin, 2007; Anwar &Sun, 2011; Azlina & Mustapha, 2012; Bekhet & Othman, 2018; Bekhet & Yasmin, 2013; Bekhet & Othman, 2011; Islam*et al.*,2013; Shahbaz*et al.*,2013). Thus, the main purpose of the current article is to supplement the existing studies on the determinants of GDP by bringing a new evidence for the case of a developed country in South East Asia (i.e., Malaysia). Unlike the previous studies for Malaysia, this study employs the autoregressive conditional Heteroscedasticity (ARCH) test proposed by Engle (1982) to either accept or reject the null hypothesis of Heteroscedasticity. If this hypothesis is rejected, then the error terms are homoscedastic and the vector error correction model (VECM) would be employed to examine the causality directions in long-run and short-run. In addition, it analyses the equilibrium relationships between GDP and its determinants by employing the econometrics approach (i.e., the autoregressive distributed lag (ARDL) approach).

2. Snapshot ofthe Malaysian economy

Over the past two decades, the Malaysian government has conducted the national vision policy and economic transformation policy. These policies have been concentrated on stimulating economic growth and achieving the 2020 vision. That is, the main objectives of these policies are to (1) focus on the high value added activities and total factor productivity in economic sectors (i.e., manufacturing, services, and agricultural). (2) Emphasize on the collaboration between private and public sectors through establishing small and medium projects. (3) Concentrate on the research activities, development activities, and human capital development. (4) Improve the sustainability of energy supply and reduce the dependence on petroleum products through encouraging the use of biofuel, biodiesel, and solar energy (United Nations Development Programme Report, 2006). The objectives of these policies however, have improved the GDP, EC, FD, and FDI growth rates. Fig. 1 shows that the GDP achieved an annual growth rate of 6% for the (1971−2013) period.

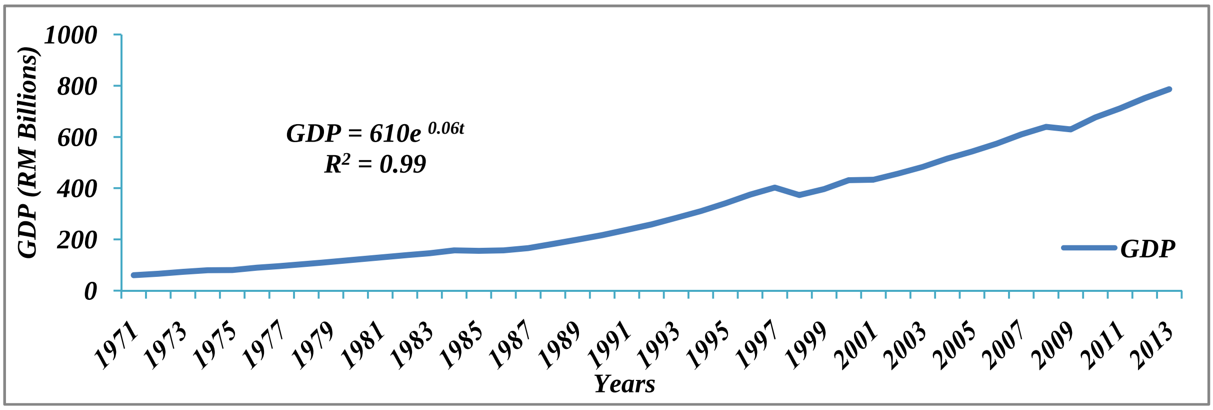

Figure 1. The growth rate of Gross Domestic Product (2010 = 100) in Malaysia for the (1971−2013) period

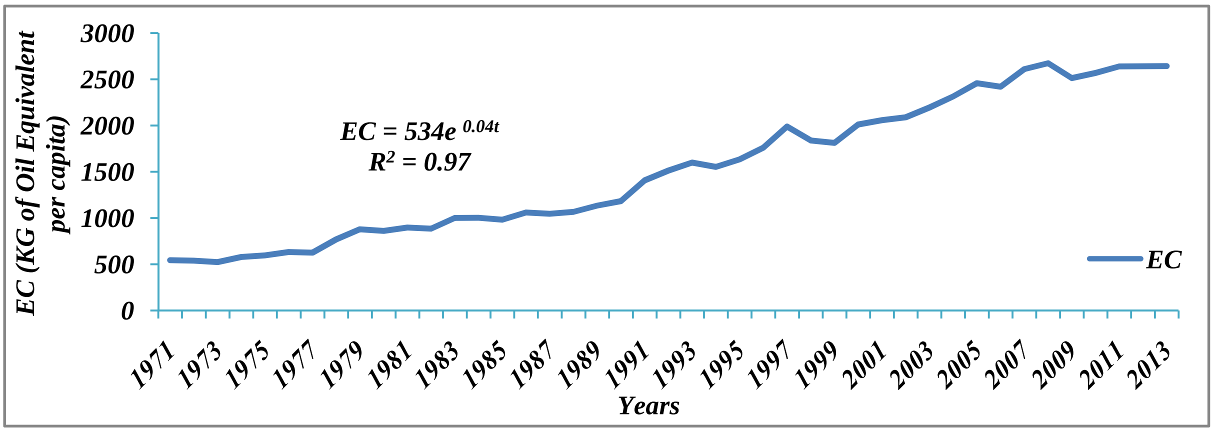

Figure 2. The growth rate of Energy Consumption in Malaysia for the (1971−2013) period

Fig. 2 demonstrates that the EC registered an annual growth rate of 4% for the (1971−2013) period. Fig. 3 shows that FD registers an annual growth rate of 3% for the (1971−2013) period.

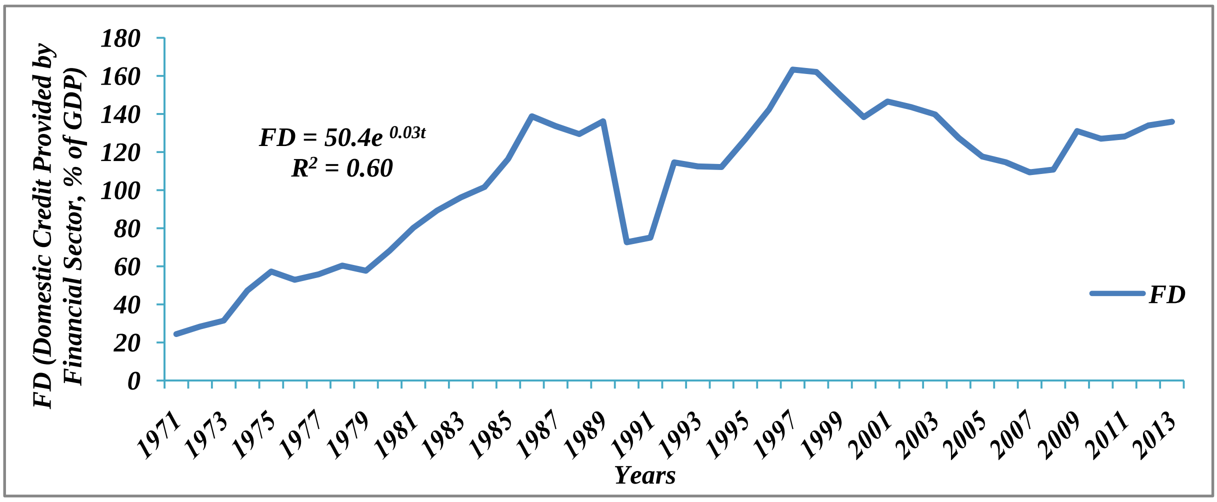

Figure 3. The growth rate of Financial Development in Malaysia for the (1971−2013) period

Fig. 4 also demonstrates that FDI inflows achieved an annual growth rate of 9% for the (1971−2013) period.

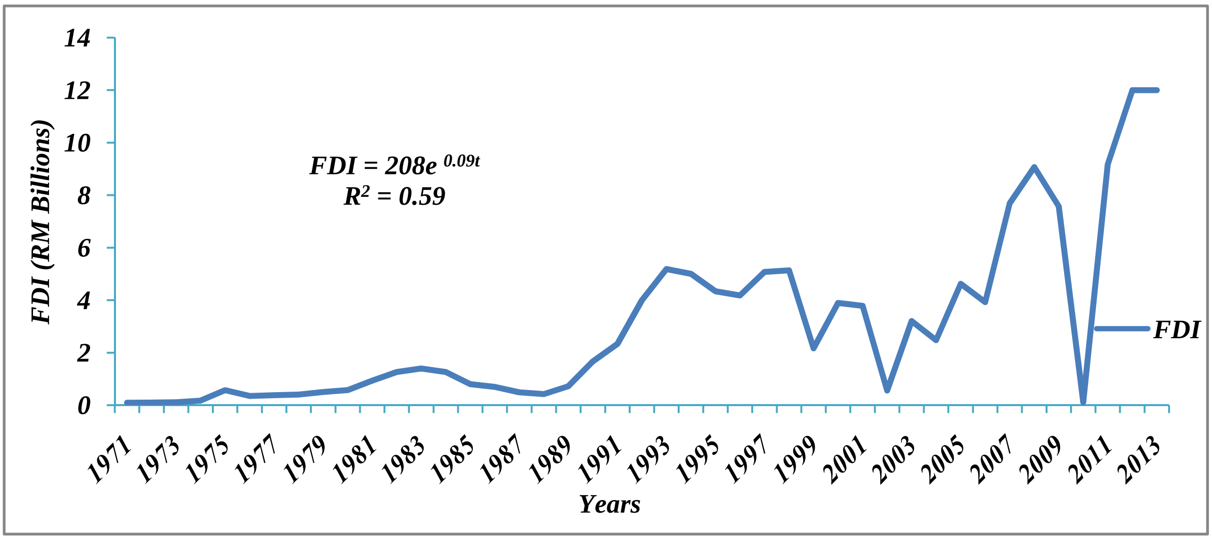

Figure 4. The growth rate of Foreign Direct Investment flows into Malaysia for the (1971−2013) period

3. Review of literature

The current paper has classified the review of literature into three groups. The first group deliberates the relationship between GDP and EC. The second group discusses the relationship between GDP and FD. The third group demonstrates the relationship between GDP and FDI.

3.1. GDP and EC

The literature includes two perspectives for the relationships between GDP and EC. The first perspective is the neutrality hypothesis which states that a country might follow an energy conservation policy that impedes GDP. For example, Alam*et al.* (2011) found no causal relationship between EC and GDP for India. Altinay and Karagol (2004), Jobert and Karanfil (2007), and Ozturk and Acaravci (2010) found similar results for Turkey, while Zhang and Cheng (2009) found them for China. The second perspective is the non-neutrality hypothesis which implies that a country's GDP is highly dependent on EC, one of the main thrusts for achieving higher GDP. Alam*et al.* (2012) found long-run bidirectional causality between electricity consumption (ELC) and GDP for Bangladesh. Apergis and Payne (2010) established bidirectional causality between EC and GDP in 20 OECD countries. Asafu-Adjaye (2000) showed bidirectional causality between EC and GDP for Thailand and the Philippines; similar results were found by Belloumi (2009) for Tunisia, Dagher and Yacoubian (2012) for Lebanon and Wang *et al.* (2011) for China. Lean and Smith (2010) pointed to unidirectional Granger causality running from ELC to GDP in the long-run for five ASEAN countries. Menyah and Wolde-Rufael (2010) established unidirectional causality running from EC to GDP for South Korea.

3.2. GDP and FD

Recently, a pool of proof in the literature has argued that FD is an important driver of GDP. Patrick (1966) argued that the relationship between FD and GDP is based in two hypotheses. The supply leading hypothesis in the case of FD causes GDP, while the demand following hypothesis if GDP causes FD. Bojanic (2012) investigated the long-run relationship and the causality direction between FD and GDP for Bolivia during the (1940−2010) period. The results indicated long-run relationship between FD and GDP. The findings also demonstrated the existence of supply-leading hypothesis (i.e., a unidirectional Granger causality from FD to GDP). Similar results were found by Hsuehe*t al.* (2013) in ten Asian countries, Lee and Chang (2009) for a set of 37 countries, Liu and Hsu (2006) for three Asian countries, namely, Taiwan, Korea, and Japan, Yang and Yi (2008) for Korea, and Zhang *et al.* (2012) for 286 Chinese cities over the (2001−2006) period. On the other hand, Liang and Teng (2006) examined the direction of causality between GDP and FD for the case of China over the (1952−2001) period. They employed the vector autoregressive (VAR) model and found a unidirectional causality running from GDP to FD. Specifically, the results confirmed the existence of the demand following hypothesis. However, the bidirectional causality between FD and GDP was established by several studies (e.g., Abu-Bader & Abu-Qarn, 2008; Al-Yousif, 2002; Calderon & Liu, 2003; Deb &Mukherjee, 2008; Hassan *et al.,* 2011). The no clear consensus on the direction of causality between FD and GDP was found by Chang (2002) in China, and Kar*et al.* (2011) in Middle East and North Africa countries for the (1980−2007) period.

3.3. GDP and FDI Inflows

The relationship between FDI inflows and GDP has been debated by diverse studies. Ang (2008a) utilized the ARDL approach to examine the relationship between FDI inflows and GDP for the case of Malaysia. The results indicated that FDIinflows stimulated GDP via promoting foreign investments. Ang and Mckibbin (2007) investigated whether FDIinflows increased GDP using annual time-series data for the (1960−2001) period. They employed co-integration and causality tests and found that FDI stimulated GDP in Malaysia. Anwar and Sun (2011) examined the relationship between FDI inflows and GDP, based on annual time-series data for the (1970−2007) period. The findings revealed that the growth of FDI in Malaysia enthused GDP. Hamdi*et al.* (2014) analysed the determinants of GDP using quarterly time-series data for the (1980−2010) period. The results indicated bidirectional causality between FDI inflows and GDP in Bahrain.

4. Model construction and data

The current paper analyses equilibrium and causality relationships among GDP, EC, FD, FDI inflows, and gross fixed capital formation (K, % of GDP) in Malaysia over the (1971−2013) period. Eq. (1) assumes that these variables determine the GDP.

$$LnGDP_t = \gamma_0 + \gamma_1 LnEC_t + \gamma_2 LnFD_t + \gamma_3 LnFDI_t + \gamma_4 LnK_t + \varepsilon_t \quad (1)$$

Where, γ_0 denotes the intercept term; γ_is [i= 1…. 4] stand for the slope parameters; and ε_t denotes the error term. All the variables used in this paper were transformed into natural logarithmic forms (Ln)s. The transformation into natural logarithmic form was used to stabilize the variance (σ^2) of secondary time-series data. The secondary time-series variables have been collected from the World Bank, Development Indicators Databases, 2017, (*http://data.worldbank.org/country/malaysia*).

5. Econometrics Methodology

Methodologically speaking, the regression results are likely to be spurious if the variables are non-stationary. The solution to the spurious phenomenon is to differentiate variables and to use co-integration mechanism. Nowadays, there are three models for implementing the co-integration mechanism: Engle and Granger's (1987) two-step process, henceforth referred to as the VAR model; Johansen and Juselius's (1990) trace and maximal eigenvalues statistics tests, hereafter referred to as the VECM; and Pesaran, Shin, and Smith's (2001) bounds F-statistics, henceforth referred to as the ARDL approach.

The VAR model in Eq. (2) is conducted under the condition that variables are not co-integrated.

$$z_t = \alpha + X_1 z_{t-1} + \ldots. + X_i z_{t-h} + \varepsilon_t, \qquad X_i \text{ (i= 1,…5)} \quad (2)$$

Where, z_t is the 5 × 1 vector of selected variables (i.e., $LnGDP_t$, $LnEC_t$, $LnFD_t$, $LnFDI_t$, and LnK_t)′. The series z_t is stationary at level (i.e.,*I(0)*) and is said to be co-integrated if the series ε_t is stationary at *I(0)*. α and ε_t are the 5 × 1 vector of intercepts and error terms, respectively. The X_i is a 5 × 5 matrix of parameters at the lag length (h). The h is obtained by using the Ackaike information criterion (AIC). Hamdi*et al.* (2014) argued that the AIC is superior and improves performance over the Schwartz information and Hannan−Quinn information criteria in a small sample size. The VECM is applied if the (ε_t)sin Eq. (2) is homoscedastic using the ARCH test under the assumption that the series z_t is stationary at the first differences (i.e., *I(1)*). Thus, Eq. (2) can be turned as in Eq. (3).

$$\Delta z_t = \Pi z_t + X_1 \Delta z_{t-1} + X_2 \Delta z_{t-2} + \ldots\ldots + X_i \Delta z_{t-h} + \varepsilon_t, \qquad X_i \text{ (i= 1,…5)} \quad (3)$$

Where, Δ denotes the first difference operator; $\prod z_t$ denotes the full rank that is used to test the null hypothesis (H_0) of no co-integration among variables.

$$\begin{bmatrix} \Delta LnGDP_t \\ \Delta LnEC_t \\ \Delta LnFD_t \\ \Delta LnFDI_t \\ \Delta LnK_t \end{bmatrix} = \begin{bmatrix} \alpha_{1t} \\ \alpha_{2t} \\ \alpha_{3t} \\ \alpha_{4t} \\ \alpha_{5t} \end{bmatrix} + \sum_{s=0}^{h} \begin{bmatrix} \beta_{11s}\ \beta_{12s}\ \beta_{13s} \\ \beta_{21s}\ \beta_{22s}\ \beta_{23s} \\ \beta_{31s}\ \beta_{32s}\ \beta_{33s} \\ \beta_{41s}\ \beta_{42s}\ \beta_{43s} \\ \beta_{51s}\ \beta_{52s}\ \beta_{53s} \end{bmatrix} \cdots\cdots \begin{bmatrix} \beta_{14s}\ \beta_{15s} \\ \beta_{24s}\ \beta_{25s} \\ \beta_{34s}\ \beta_{35s} \\ \beta_{44s}\ \beta_{45s} \\ \beta_{54s}\ \beta_{55s} \end{bmatrix} \begin{bmatrix} \Delta LnGDP \\ \Delta LnEC \\ \Delta LnFD \\ \Delta LnFDI \\ \Delta LnK \end{bmatrix}_{t-s} + \begin{bmatrix} \zeta_{1t} \\ \zeta_{2t} \\ \zeta_{3t} \\ \zeta_{4t} \\ \zeta_{5t} \end{bmatrix} \begin{bmatrix} EET \\ EET \\ EET \\ EET \\ EET \end{bmatrix}_{t-1} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \end{bmatrix} \quad (4)$$

Where, Eq. (4) represents the VECM; Δ is the first difference operator; α_{it} [i= 1,…. 5] represent the intercept terms; β_{ij} [i,j= 1,…., 5] denote the F-statistics coefficients to evaluate the causality directions in the short-run; ζ_{it} [i= 1,…. 5] signify the t-statistics coefficients of equilibrium error terms (EET_{t-1})s that are used to evaluate the bidirectional causality in long-run; and ε_{it} [i= 1,…. 5] are the disturbance terms.

The ARDL approach has been employed in this paper to analyselong-run and short-run relationships among variables. Bekhet and Mugableh (2012), Bekhet and Mugableh (2013), Bekhet and Mugableh (2016), Mugableh (2013, 2015a, 2015b, 2015c, 2017a, 2017b) and Narayan (2005) argued that this approach has statistical and econometrics advantages. (1) The ARDL approach can be utilized in a small sample size (i.e., less than 80 observations). (2) It can envelop the variables at *I(0)*, *I(1)*, and both. Eq. (5) explains the coefficients of long-run and short-run relationships through the ARDL approach.

$$\begin{aligned} \Delta LnGDP_t &= \alpha_0 + \alpha_{1t} LnGDP_{t-1} + \alpha_{2t} LnEC_{t-1} + \alpha_{3t} LnFD_{t-1} + \alpha_{4t} LnFDI_{t-1} + \alpha_{5t} LnK_{t-1} \\ &+ \sum_{s=1}^{h} \alpha_{6s} \Delta LnGDP_{t-s} + \sum_{s=0}^{h} \alpha_{7s} \Delta LnEC_{t-s} + \sum_{s=0}^{h} \alpha_{8s} \Delta LnFD_{t-s} \\ &+ \sum_{s=0}^{h} \alpha_{9s} \Delta LnFDI_{t-s} + \sum_{s=0}^{h} \alpha_{10s} \Delta LnK_{t-s} + \varepsilon_t \end{aligned} \quad (5)$$

Here, Δ represents the first difference operator; α_0 denotes the intercept term; α_{it} [i= 1, …. 5] represent the long-run coefficients that are used to test long-run relationships; α_{is} [i= 6,…. 10] denote the short-run coefficients to estimate short-run relationships; h signifies the lag length that obtained by the AIC; and ε_t is the error term.

6. Results analyses and discussions

6.1. Descriptive statistics test

Table 1 provides the findings of descriptive statistics tests. The correlation matrix results show that the variables are departed from dependence (i.e., linearly correlated).

Table 1. Descriptive statistics test results.

	$LnGDP_t$	$LnEC_t$	$LnFD_t$	$LnFDI_t$	LnK_t
Mean	3.0911	33084.9	104.93	3.8005	27.825
Median	2.4811	27711.2	114.59	3.6253	25.318
Maximum	7.5111	75907.3	163.35	8.7628	43.586
Minimum	6.0411	6092.98	24.449	0.0567	20.570
Stand. Dev.	2.0911	23489.7	38.348	1.8407	6.8389
Skewness	0.5726	0.52615	-0.569	0.5608	1.0085
Kurtosis	2.0480	1.87294	2.1903	3.5022	2.7362
Jarque−Berra	3.8807	4.16080	3.4159	2.6426	5.2419
Probability	0.1437	0.12488	0.1812	0.2668	0.1068
$LnGDP_t$	1.00				
$LnEC_t$	0.89	1.00			
$LnFD_t$	0.55	0.71	1.00		
$LnFDI_t$	0.02	0.07	-0.01	1.00	
LnK_t	-0.14	-0.05	0.17	0.67	1.00
R^2	0.87				
D−W	1.68				

Source: The output of E-views econometric software package (version 8.1).

Table 1 also shows that the H_0 of non-normality has been rejected as the probability values of Jarque−Berra statistics test are greater than 10%. There is no evidence of spurious regression because the joint coefficient of determination (R^2) equals 0.87 and less than 1.68 (i.e., the Durbin−Watson statistics (D−W) value).Thus, these results lead us to further examining the equilibrium and causality relationships between GDP and its determinants.

6.2. ARCH test

Table 2 demonstrates that the H_0 of Heteroscedastic co-integrating relationship for the (ε_t)sin Eq. (3) is rejected. The F-statistics probability value (i.e., 0.14) and the chi-square (χ^2) probability value (i.e., 0.12) are greater than 10%. Brooks (2008) argued that if F-statistics and the χ^2 probabilities values are greater than 10%, the H_0 of the Heteroscedastic co-integrating relationship would be rejected.

Table 2. ARCH test results.

	Computed value	Probability value
F-statistics (q, 35)	1.96	0.14
$T \times R^2$ (χ^2 (q))	36.5	0.12

Notes: (1) T is the number of observations.

(2) q denotes the degree of freedom which equal the number of (h = 3) that obtained using AIC.

Source: The output of E-views econometric software package (version 8.1).

In other words, there is a homoscedastic co-integrating relationship and the VECM would be employed to examine the causality directions in long-run and short-run. Before using VECM and ARDL approach we have to confirm that the variables are stationary at *I(1)* using Kwiatkowski, Phillips, Schmidt, and Shin, KPSS (1992) test

6.3. Stationary test

The third step in this paper is to determine the integration level of variables. The stationary testing is mandatory to detect the stability of time-series data. Harris (1995) argued that the non-stationary variables are contained random and deterministic time trends. In other words, the appropriate procedure is to differentiate time-series variables in order to remove these trends. However, the KPSS test has been employed to decide the integration levels of variables. The results in Table 3 show that the variables are stationary at *I(1)*.

Table 3. KPSS test results

Variables	KPSS LM computed test statistics values	Decision
$LnGDP_t$	0.35^{*}	Stationary at *I(1)*
$LnEC_t$	0.36^{*}	Stationary at *I(1)*
$LnFD_t$	0.23^{*}	Stationary at *I(1)*
$LnFDI_t$	0.13^{**}	Stationary at *I(1)*
LnK_t	0.26^{*}	Stationary at *I(1)*

Notes:(1)The KPSS LM computed test statistics values are compared with the asymptotic critical values (i.e., 1% = 0.22, 5% = 0.15, and 10% = 0.12).

(2) $^{*, **}$represent the significance at 1% and 10% levels, respectively.

(3) The analysis was conducted using intercept and time-trend.

Source: The output of E-views econometric software package (version 8.1).

Thus, the VECM is employed to evaluate the causality directions in long-run and short-run. Also, the ARDL approach is utilized to examine long-run and short-run relationships.

6.4. Co-integration test

The fourth step is principally important to either accept or reject the H_0 of no co-integration. However, the results in last subsection confirm that the variables are stationary at *I(1)*, then the full rank (i.e., $\prod z_t$, Eq. (3)) is employed to test co-integration among variables. In fact, the $\prod$ represents the number of eigenvalues in the trace statistics test (λ trace) and maximal statistics test (λ max). Table 4 demonstrates the existence of two co-integrating vectors among variables. These results are in line with the results obtained for Bahrain using bounds F-statistics test (Hamdi*et al.*, 2014).

Table 4. Co-integration test results for the $LnGDP_t$ function.

No. of C.V	λ trace	5% critical values	λ max	5% critical values
r = 1→	96.5*→	69.8	44.9*→	33.9
r = 2→	51.6*→	47.9	29.8*→	27.6
r = 3	21.8	29.8	16.8	21.1
r = 4	5.00	15.5	4.97	14.3
r = 5	0.03	3.84	0.03	3.84

Notes:

(1)r is the number of co-integrating vectors (C.V).

(2) *represents the existence of co-integrating relationships at the 5% significance level.

(3) The 5% critical values were obtained from Mackinnon *et al.*(1999, p. 570).

Source: The output of E-views econometric software package (version 8.1).

6.5. VECM Granger causality analyses

The results of the ARCH test confirm the existence of a homoscedastic co-integration relationship among the variables. Thus, the VECM in Eq. (4) is employed to determine the causality directions in long-run and short-run. Table 5 shows bidirectional Granger causality between variables in long-run, as the coefficients of (EET_{t-1})s are in negative signs and significant at the 1% and 5% levels. These results are in line with the findings obtained for India and Bahrain (see Boutabba, 2014 and Hamdi*et al.,* 2014, respectively).

Table 5. VECM Granger causality analyses results.

Variables	Sources of causation					
	Short-run					Long-run
	$\Delta LnGDP_t$	$\Delta LnEC_t$	$\Delta LnFD_t$	$\Delta LnFDI_t$	ΔLnK_t	
$\Delta LnGDP_t$	–	2.77(0.06)*	0.27(0.84)	0.46(0.71)	0.63(0.60)	-0.2(0.03)**
$\Delta LnEC_t$	1.25(0.31)	–	2.29(0.10)*	1.16(0.34)	0.34(0.80)	-0.6(0.00)***
$\Delta LnFD_t$	0.47(0.70)	0.23(0.88)	–	2.11(0.11)	2.31(0.10)*	-0.7(0.00)***
$\Delta LnFDI_t$	1.09(0.37)	1.67(0.19)	0.78(0.52)	–	1.66(0.20)	-1.6(0.00)***
ΔLnK_t	0.76(0.52)	1.79(0.17)	1.07(0.37)	1.08(0.37)	–	-2.7(0.01)***

Note: ***, **, *denote the 1%, 5%, and 10% significance levels, respectively.

Source: The output of E-views econometric software package (version 8.1).

The long-run bidirectional Granger causality between $\Delta LnFD_t$ and $\Delta LnGDP_t$ confirms the existence of supply and leading hypotheses in Malaysia. Table 5 also shows a unidirectional Granger causality running from $\Delta LnEC_t$ to $\Delta LnGDP_t$; $\Delta LnFD_t$ to $\Delta LnEC_t$; and ΔLnK_t to $\Delta LnFD_t$. The unidirectional Granger causality from $\Delta LnEC_t$ to $\Delta LnGDP_t$ is similar to the finding obtained for South Korea (Menyah & Wolde-Rufael, 2010). Therefore, the non-neutrality hypothesis is existed in Malaysia because the GDP is highly dependent on the EC.

6.6. Equilibrium relationships analyses

The ARDL approach has been implemented to estimate long-run and short-run relationships in Eq. (5). Table 6 demonstrates that $LnEC_{t-1}$, $LnFD_{t-1}$, $LnFDI_{t-1}$, and LnK_{t-1} are positively associated with the $\Delta LnGDP_t$ in the long-run.A 1% increases in energy consumption and gross fixed capital formation add in economic growth by 0.98 and 14.2, respectively.A 1% increases in financial development and foreign direct investment inflows improve economic growth by 0.27 and 0.25, respectively. These results are confirmed by the findings obtained for Bahrain (Hamdi*et al.,* 2014).

Table 6. Equilibrium relationships analyses results.

Dependent variable = $LGDP_t$			
Variable	Coefficient	Standard error	Probability value
Panel A: Long-run analysis results			
Constant	16.9***	0.50	0.01
$LnEC_{t-1}$	0.98*	0.05	0.10
$LnFD_{t-1}$	0.27*	0.14	0.10
$LnFDI_{t-1}$	0.25*	0.16	0.10
LnK_{t-1}	14.2***	0.65	0.01
R^2	0.88		
Adj-R^2	0.85		
Panel B: Short-run analysis results (the lag order = 0, 0, 0, 0, 1 based on the AIC)			
$\Delta LnEC_t$	0.19***	0.07	0.01
$\Delta LnFD_t$	-0.05**	0.02	0.02
$\Delta LnFDI_t$	0.01**	0.01	0.05
ΔLnK_t	0.16**	0.04	0.02
ΔLnK_{t-1}	-0.10**	0.04	0.03
R^2	0.67		
Adj-R^2 0.59			
Panel C: Diagnostic tests:			
	Test	F-statistics	Probability value
	χ^2 Serial	0.22	0.26
	χ^2 ARCH	0.31	0.42
	χ^2 White	0.66	0.88
	χ^2 Ramsey	0.29	0.31

Notes: (1) ***, **,* represent the significance at 1%, 5%, and 10% levels, respectively.

(2) χ^2 Serial is for serial correlation, χ^2 ARCH for autoregressive conditional heteroscedasticity, χ^2 White for white heteroscedasticity, and χ^2 Ramsey for Ramsey reset test.

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Source: The output of Micro-Fit econometric software package (version 5.1).

Table 6 also shows that $\Delta LnEC_t$, $\Delta LnFDI_t$, and ΔLnK_t are positively linked with the $\Delta LnGDP_t$ in the short-run. In contrast, the $\Delta LnFD_t$ and ΔLnK_{t-1} are negatively associated with the $\Delta LnGDP_t$. The results of diagnostic tests are detailed in Panel C of Table 6. These results show that there is no evidence of serial autocorrelation and Heteroscedasticity.

6.7. Impulse response function test

Pesaran and Shin (1998) argued that the impulse response function (IRF) is a generalized forecast of error standard deviation to test the strength and credibility of causal relationship between variables. In fact, the VECM Granger causality test has a limitation. This test cannot capture the strength and credibility of causal relation between the variables. To solve this issue, however, we employed the IRF test. This test is based on the VAR model to display the reaction in one variable due to shocks stemming in other variables.Fig. 5 indicates a positive response in the GDP due to standard shocks stemming in the EC over the next 10 periods. The contribution of the FD in the GDP is positive but becomes negative after the second year. Both of the FDI and K contribute positively in the GDP but their contributions in the GDP become negatively after the next fifth year.

Response to Cholesky One S.D. Innovatios (+, -) 2 S.E.

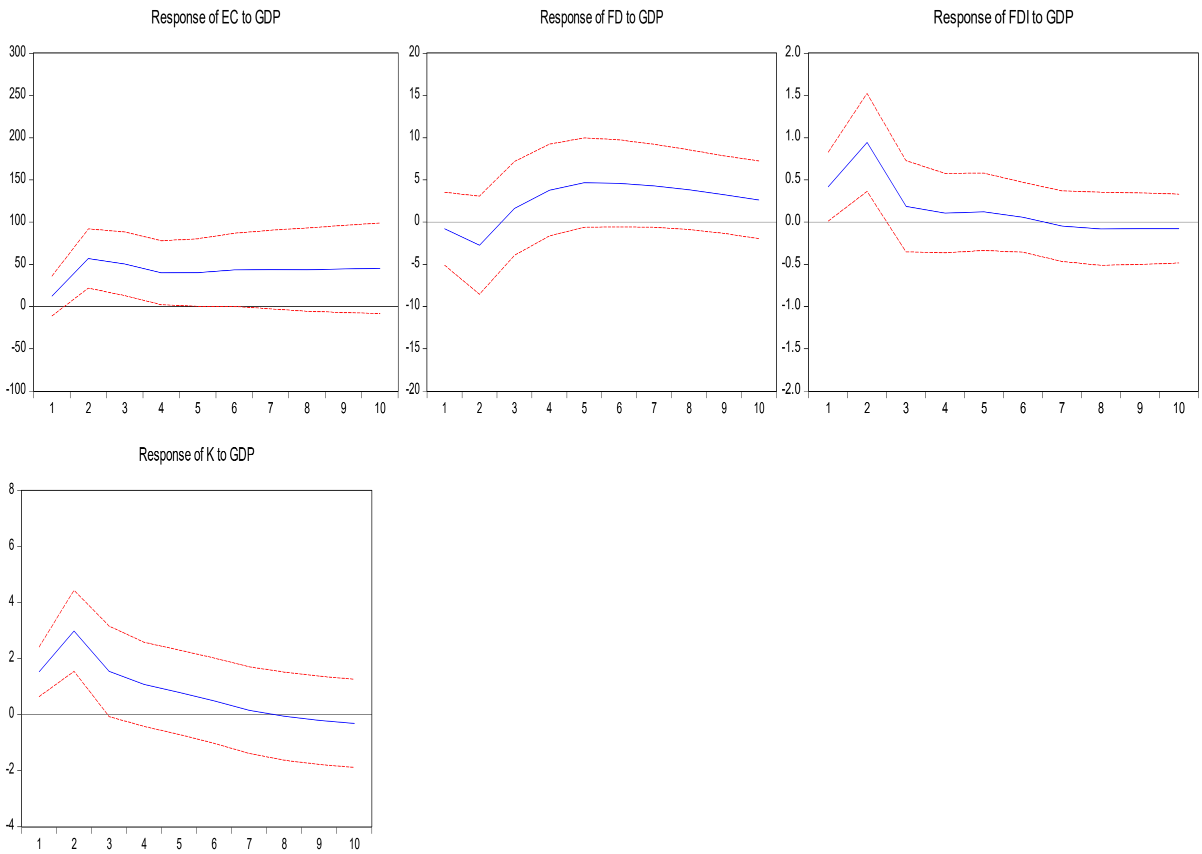

Figure 5. Impulse response function

Source: The output of E-views econometric software package (version 8.1).

7. Conclusions

This paper re-analyses equilibrium relationships and causality directions among economic growth, energy consumption, financial development, foreign direct investment inflows, and gross fixed capital formation in Malaysia for the (1971−2013) period. The results of descriptive statistics tests show that variables have stable econometrics properties (i.e., $(\varepsilon t)s \sim N(0, \sigma^2)$). The H_0 of Heteroscedasticity among variables has been rejected confirming the usage of VECM. The findings of KPSS test demonstrate that variables are stationary at $I(1)$. The trace and maximal eigenvalues statistics tests display the existence of two co-integrating vectors among variables. However, the VECM results show long-run bidirectional Granger causality among variables as the coefficients of (EET_{t-1})s are significant and in negative signs. Furthermore, a short-run unidirectional Granger causality has been detected from energy consumption to economic growth; financial development to energy consumption; gross fixed capital formation to financial development. The ARDL findings show that energy consumption, financial development, foreign direct investment inflows, and gross fixed capital formation boost economic growth in long-run.

8. Policy implications and further study

The mutual long-run bidirectional Granger causality among variables suggest the following notes:

a) The bidirectional Granger causality between economic growth and energy consumption suggest the existence of non-neutrality hypothesis. The Malaysian economy is highly dependent on the consumption of energy to achieve the desired economic growth rate, 7%, by 2020 (Economic Transformation Policy Report, 2012).

b) The bidirectional Granger causality between economic growth and financial development implies the supply and leading hypotheses. The endogenous growth theory suggests that financial development is an important driver of economic growth through the allocation of resources, capital accumulation, and technological innovation (Bencivenga & Bruce, 1991; Greenwood & Jovanovic, 1990).

c) The bidirectional Granger causality between economic growth and foreign direct investment inflows indicates that foreign direct investment inflows would spur economic growth of the host country directly through the diffusion of technologies and accumulation of gross fixed capital formation. Also, the foreign direct investment inflows would promote economic growth indirectly through labour training and skills acquisition.

Therefore, the Malaysian government ought to continue implementing the national vision and economic transformation policies in order to spur economic growth. The emphasis on the total factor productivity strategy is necessary to boost high value activities in manufacturing, services, and agriculture sectors, which in turn improves the quality and quantity of output.

The collaboration between private and public sectors is mandatory to establish more small and medium projects that ultimately attracts foreign investments and improves the output. The reduction of the dependence on the petroleum products through the usage of biofuel, biodiesel, and solar energy encourage the consumption of energy which is necessary to foster economic growth. However, a further research could be done to re-examine the determinants of economic growth by adding employment levels in economic sectors.

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