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Economic Growth, Financial Development, Energy Consumption and Life Expectancy: Fresh Evidence from ASEAN Countries

Ernie Hendrawaty[1], Mohd Shahidan Shaari[2]*, Fajrin Satria Dwi Kesumah[1], Abdul Rahim Ridzuan[3]

[1]Faculty of Economics and Business, Universitas Lampung, Lampung, Indonesia, [2]Faculty of Applied and Human Sciences, Universiti Malaysia Perlis, Malaysia, [3]Faculty of Business and Management, Universiti Teknologi MARA, Malaysia.
*Email: shahidanshaari@unimap.edu.my

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ABSTRACT

The study examines the relationship between economic growth and life expectancy by considering the potential role of financial development and energy consumption in ASEAN Countries. Unit root testing was applied to check the level stationarity data before checking for cointegration between variables using the error correction term (ECT) approach, and ARDL bounds testing was applied for cointegration with structural damage that occurred at a specific time using the pooled mean group (PMG) and pooled mean group (MG). The empirical results showed the existence of cointegration among variables. PMG was selected based on Hausmann Test that indicated energy consumption could significantly and positively affect life expectancy. Therefore, ASEAN countries would be extensively dependent on non-renewable energy to generate their economic activities in the long run. In contrast, in the short run, higher economic growth can reduce life expectancy in most developing countries, as energy consumption is examined to affect life.

Keywords: Economic Growth, Financial Development, Energy Consumption, Life Expectancy, ASEAN
JEL Classifications: E6, F37, F43, F47

1. INTRODUCTION

High levels of economic growth followed by achieving a better quality of life for the people are desirable for policymakers, especially in developing countries (Wang et al., 2020). It also means higher economic growth has traditionally resulted in rapid economic development throughout the country. Therefore, as a stakeholder and a policymaker, the government strives to make the best strategy to encourage economic growth in their respective countries. Meanwhile, Todaro and Smith (2009) conducted empirical research found that most developing countries in 1950-1960 had achieved their economic growth targets efficiently, but on the other hand, they could not transform this into more conditions of people's lives better. Therefore, today, many countries have realized and changed their priorities, where the focus of development is towards increasing economic growth, providing better health and education facilities, and alleviating poverty. Therefore, economic growth without the quality of life is not the best choice for nations, even though economic growth is considered the primary indicator for advancing the livelihoods of nations.

An increase in life expectancy can be associated with an increase in people's income in a country. Shahbaz et al. (2016) found that an increase in per capita income is a reflection of the high life expectancy of the community, which means that it depends on how a country invests in improving social indicators such as health, education, pension plans, food facilities, sanitation plans, and improving environmental status. Furthermore, Claessens and Feijen (2007) found a causal relationship between financial development and life expectancy, where the growth of industrialization as a door to employment was encouraged by increasing investment development. This financial growth may also have implications for improving the community's standard of living in the form of better health and nutrition; the better the standard of life of the community to positively affect life expectancy in the long term. Shahbaz et al. (2019) also argued that the growth of a country's investment rate also has an essential role in developing education, driving public health status and life expectancy in the right direction.

This study examines the impact of economic growth and financial development on life expectancy in ASEAN empirically. Furthermore, the contribution of this research is to fill the gaps in previous research, focusing on countries in the ASEAN region and providing policy recommendations that are directly related to increasing life expectancy in ASEAN. In this study, unit root testing was carried out to check the level of static data before checking for cointegration between variables using the error correction term (ECT) approach. Then the ARDL panel boundary testing approach was also applied to check for cointegration with structural damage that occurred at a specific time using the pooled mean group (PMG) and Pooled Mean Group (MG). Finally, the Hausman test was carried out to select the best estimator between PMG or MG, where the two estimators have different assumptions.

2. LITERATURE REVIEW

The main objectives of this study are to measure the effects on GDP and financial development and energy consumptions on life expectancy in five ASEAN countries, including Indonesia, Malaysia, Singapore, Thailand, and the Philippines.

2.1. Effect of Economic Growth (GDP) on Life Expectancy

Previous studies on the relationship between GDP and life expectancy had been widely conducted in various regions and specific periods. The latest study of Wang et al. (2020) positively found the significance of GDP on Pakistani's life expectancy. The study employed the ARDL model to test the cointegration between variables observed from 1972 to 2017. Sirag et al. (2019), in their empirical study, examined that life expectancy has a crucial contribution to economic growth until a certain level. Another study, like Dang and Pheng (2015), measured the panel model of fifty-six emerging countries in North Africa, the Middle East and Asian countries to explore the long-term relationship between GDP and life expectancy. The finding is also supported in Biyase and Malesa (2019), which measured data in ten South African Countries from 1985 to 2017, applying two-stage least squares and concluded the positive effect of life expectancy on economic growth.

However, Acemoglu and Johnson (2007) examined the negative linkage between economic growth and life expectancy. They proved that statistically, there was a negative and not significant relationship between life expectancy and GDP variable among forty-seven developed, middle, and developing countries.

2.2. Effect of Financial Development on Life Expectancy

An initial study by Kindleberger (1978) explained that management in finance directly affects a country's economic growth. They argued that a country could have a crisis if it did not manage its financial affairs wisely. The finding further explained that if financial development were not well managed, it would decrease the government spending on health, insurance, and in the worst case, it could reduce life expectancy. In a recent study, Sehrawat and Giri (2017) examined the linkage between financial development and life expectancy in ten selected Asian countries. Their finding was a positive impact on financial development for better financial levels, better life quality standards, and better life expectancy.

On the other hand, Nik et al. (2013) argued a significant influence but unfavorable for the financial development on life expectancy in their empirical study. This different finding was argued because the systems and schemes on banking were poor and unplanned regarding financial means, funds, and resource provisions.

2.3. Effect of Energy Consumption on Life Expectancy

In their empirical study, Zaidi et al. (2018) proved that energy consumptions in developed and developing countries are considered the fundamental cause for economic growth. However, in the last few decades, environmental and energy economics have become popular because they increase the threats of gas emissions, contributing to global warming. Sarkodie et al. (2019) explored that increasing energy consumption in European countries intensively causes a declining life expectancy. On the contrary, Schwartz et al. (2018) contributed to literature that there is a positive relationship between environmental degradation and life expectancy.

3. METHODOLOGY

This study uses panel data over 30 years ranging from 1988 to 2018. Data on several important variables, namely financial development, economic growth, energy consumption and life expectancy, were collected from the World Bank and countryeconomy.com. Life expectancy was measured by the number of years a person may expect to live. Economic growth was measured by real gross domestic product (GDP), financial development was measured by domestic credit to the private sector, and energy consumption was measured by electricity consumption. Table 1 shows a description of each variable, and the model specification is as follows:

$$LE_{it}=\alpha_i+\varnothing_1\ GDP_{it}+\varnothing_2\ EC_{it}+\varnothing_3\ FD_{it}+\varepsilon_{it} \quad (1)$$

Where by

LE_{it} = Life Expectancy

GDP_{it} = Economic Growth

EC_{it} = Energy Consumption

Table 1: Variable Description

Variable	Proxy	Units of measurement
Financial Development (FD)	Domestic Credit to Private Sector	% of GDP
Economic Growth (GDP)	Gross Domestic Product	Constant 2010 USD
Energy Consumption (EC)	Electricity Consumption	GWh
Life Expectancy (LE)	Life Expectancy at Birth	Total years

FD_{it} = Financial Development
$\varnothing_j$ = Parameter
ε_{it} = Error Term
α_i = Intercept

3.1. Co-integration Test

Pedroni (1999) introduced a panel cointegration approach to confirm a long-run relationship, and the equation is as follows:

$$y_{it}=a_i+p_{it}+b_1 Z_{1it}+\ldots+b_n Z_{mit}+\mu_{it} \quad (2)$$

Where y and z are integrated, p represents the cointegration term, a represents intercept and $b_1\ldots b_n$ represent the coefficients. According to Pedroni (1999), there are seven statistical tests to examine cointegration. Out of seven, four statistics are tested within the dimension, and the other three are tested between dimensions. The null hypothesis, H_0: p_i=1, suggests that there is no cointegration while the alternative hypothesis, H_0: p_i<1, indicates that there is cointegration.

3.2. Panel ARDL

A dynamic panel data analysis has recently come to the fore. Many previous studies used the analysis to examine various impacts, including the impact of economic growth on life expectancy, such as Murth et al. (2021). This approach is the most suitable when the number of cross-sectional units (N) is higher than the number of time periods (T). If N is larger than T, the GMM approach is more appropriate. This study used Pooled Mean Group (PMG) and Pooled Mean Group (MG) in the panel ARDL analysis, introduced by Pesaran et al. (1999). The ARDL model is as follows:

$$\Delta lnLE_{it} = \varnothing_i lnLE_{it-1} + \beta_{1i} lnGDP_{i,t-1} + \beta_{2i} lnEC_{i,t-1} + \beta_{3i} lnFD_{i,t-1} + \sum_{j=1}^{p-1} \lambda_{ij} \Delta lnLE_{i,t-j} + \sum_{j=1}^{p-1} \gamma_{1ij} \Delta lnGDP_{i,t-j} + \sum_{j=1}^{p-1} \gamma_{2ij} \Delta lnEC_{i,t-j} + \sum_{j=1}^{p-1} \gamma_{3ij} \Delta lnFD_{i,t-j} + n_i + \varepsilon_{it} \quad (3)$$

Where lnLE is treated as a dependent variable while lnGDP, lnEC and lnFD are treated as independent variables. i represents the groups while n represents the fixed effects. β represents the vector coefficient, and λ repesents the lag coefficient of the first difference for the dependent variable. γ indicates the vector coefficient of the first difference for the independent variables, assuming that ε_{it} is independently distributed. From Equation 3, we can include the error correct term. Therefore, a new equation is as follows:

$$\Delta lnLE_{it} = \pi_i ECT_{it-1} + \sum_{j=1}^{p-1} \lambda_{ij} \Delta lnLE_{i,t-j} + \sum_{j=1}^{q-1} \gamma_{1ij} \Delta lnGDP_{i,t-j} + \sum_{j=1}^{q-1} \gamma_{2ij} \Delta lnEC_{i,t-j} + \sum_{j=1}^{q-1} \gamma_{3ij} \Delta lnFD_{i,t-j} + n_i + \varepsilon_{it} \quad (4)$$

ECT represents the error correction term while π_i is the coefficient of the error correct term that measures the speed of adjustment to correct the disequilibrium in the long run.

3.3. Hausman test

This study uses the Hausman test to choose the best estimator, PM or MG, as both estimators have different assumptions. Pirotte (1999) concluded that the MG estimator is more appropriate for a large sample size that uses a long time period. Pesaran et al. (1999) stated that there is no coefficient value for each individual or country in the long run. The PMG estimator can only capture a coefficient value in the short run for each individual or country. However, to test whether PMG or MG is more efficient, the Hausman test must be conducted. If the null hypothesis is accepted, the PMG estimator is favorable. If the null hypothesis is rejected, the MG estimator is favorable.

4. FINDINGS

The results of the descriptive statistics are reported in Table 2. From the table, it can be learned that economic growth shows the highest maximum (27.7680) while life expectancy shows the lowest maximum (4.4206). This study uses data for over 30 years ranging from 1988 to 2018 from the ASEAN-5 countries. Before we proceed with our analysis of the effects of economic growth and financial development on life expectancy, the VIF test was conducted, and the results showed that the VIF values for all variables are lower than 10. According to the rule of thumb, the value of VIF is lower than 10, which indicates that the independent variables used in the study were free from multicollinearity. Therefore, the model could be regressed.

Another issue that must be taken into account before employing the panel ARDL approach is unit-roots. The approach can provide consistent estimators regardless of whether the order of integration is I(I) or I(0). Unit root tests based on ADF and IPS were performed to check the presence of stationary in our data, and the results are reported in Table 3. The tests produce the results at the level and first difference. The results reveal that the order of integration is I(0). We can see that the variables (economic growth and life expectancy) are not stationary at the level and stationary at the first difference, while financial development and energy consumption are stationary at both level and first difference.

Once the model has passed the VIF and unit root tests, the next issue that needs to be considered is cointegration. Pedroni (1999) introduced several statistics that can indicate whether our variables

Table 2: Descriptive statistics results

	lnLE	lnGDP	lnFD	lnEC
Mean	4.2965	26.0513	4.2550	10.9047
Median	4.2928	25.9937	4.5607	10.7933
Maximum	4.4206	27.7680	5.0658	12.4250
Minimum	4.1826	24.7637	2.7802	9.3625
Std. Dev	0.0585	0.6782	0.6310	0.7775
Skewness	0.3723	0.5521	–0.6424	0.1417
Kurtosis	2.3728	2.9870	2.0045	2.0039
Jarque-Bera	4.5416	5.8433	12.6583	5.1392
Probability	0.1032	0.0538	0.0018	0.0766
VIF	-	7.06	1.14	7.21

lnLE represents life expectancy, lnGDP represents GDP, lnFD represents financial development, and lnEC represents energy consumption

Table 3: Panel unit root tests results

Variable	ADF		IPS	
	Level	1st difference	Level	1st difference
lnLE	1.7614 (0.9979)	91.6193*** (0.0000)	2.7580 (0.9979)	–16.3544 (0.0000)
lnGDP	5.7132 (0.8388)	39.1757*** (0.0000)	2.5858 (0.9951)	–4.5144 (0.0000)
lnFD	18.6631** (0.0448)	32.1337*** (0.0004)	–1.9293** (0.0268)	–2.49599 (0.0063)
lnEC	38.8104*** (0.0000)	49.5675*** (0.0000)	–3.24954*** (0.0006)	–5.4431 (0.0000)

*** and** show the significance levels of 1% and 5%, respectively. The probability values are in parentheses. lnLE represents life expectancy, lnGDP represents GDP, lnFD represents financial development, and lnEC represents energy consumption

are co-integrated. Table 4 shows the results of panel cointegration. From the table, it can be learned that the results are mixed, with 2 of 7 statistics rejecting the null hypothesis. According to Baek (2016), since the results are mixed – some statistics show that our variables are co-integrated, while others show that our variables are not co-integrated. It is necessary to check the error correction term (ECT) to confirm the cointegration. If the value of ECT is significantly negative and lower than 1, it can be concluded that our variables are co-integrated.

Table 4: Panel co-integration results

	Within Dimension
Panel v-Statistic	19.9892*** (0.0000)
Panel rho- Statistic	0.5145 (0.6966)
Panel PP-Statistic	–0.4477 (0.3272)
Panel ADF-Statistic	1.4475 (0.9261)
	Between Dimension
Group rho- Statistic	1.6460 (0.9501)
Group PP-Statistic	–2.6410*** (0.0041)
Group ADF- Statistic	0.7117 (0.7617)

Table 5 shows the results of long-run estimation using two estimators, namely PMG and MG. The results of the Hausman test show that the p-value is 0.3508, and thus the null hypothesis is accepted. This result suggests that PMG is the most efficient estimator for our model. The results of PMG showed that economic growth could significantly and positively affect FDI in the long run. This result is consistent with the result of MG. The coefficient value is 0.1910, indicating that a 1% increase in infrastructure can increase life expectancy by 0.19%. A higher standard of living can improve life expectancy in the long run. Other than that, the results also showed that financial development could significantly and negatively influence life expectancy. The coefficient value is 0.0138. This implies that a 1% rise in financial development can decrease life expectancy by 0.01%. Higher financial development does not help boost life expectancy. Instead, it threatens life expectancy. However, the results of MG did show any significant relationship between financial development and life expectancy in the long run. Other than that, the results also showed that energy consumption could significantly contribute to lowering life expectancy. The coefficient value is –0.1528, meaning that if energy consumption goes up by 1%, life expectancy will decrease by 0.15% in the long run. This means that using more non-renewable energy could pollute the environment, affecting life expectancy. The MG estimator also showed the same results.

Table 5: Long-run estimation results

Independent variables	PMG	MG
lnGDP	0.1910*** (0.000)	0.1240* (0.073)
lnFD	–0.0138** (0.039)	0.0172 (0.461)
lnEC	–0.1528*** (0.000)	–0.0930** (0.033)
Hausman (prob.)	3.28 (0.3508)	

***, ** and * show the significance levels of 1%, 5% and 10%, respectively. The probability values are in parentheses. lnLE represents life expectancy, lnGDP represents GDP, lnFD represents financial development, and lnEC represents energy consumption

Table 6 shows the results of short-run estimation using the two estimators (PMG and MG). The value of ECT is significantly negative and lower than 1. This result means that cointegration exists among the variables (life expectancy, economic growth, financial development and energy consumption). Due to the results of the Hausman test that favored the PMG estimator, it can be learned that energy consumption can significantly and positively affect life expectancy, meaning that energy diversification in the short run helps increase life expectancy. However, the countries are still extensively dependent on non-renewable energy to generate their economic activities in the long run.

Table 6: Short-run estimation results

Variables	PMG	MG
ECT	–0.0209*** (0.0317)	0.0220* (0.080)
lnGDP	–0.0229 (0.197)	–0.0020 (0.357)
lnFD	0.0022 (0.200)	0.0001 (0.874)
lnEC	0.0069** (0.005)	0.0013 (0.324)
Constant	0.0231 (0.406)	

***, ** and * show the significance levels of 1%, 5% and 10%, respectively. The probability values are in parentheses. lnLE represents life expectancy, ln GDP represents GDP, lnFD represents financial development, and lnEC represents energy consumption

Table 7 shows the results of the short-term effects in the ASEAN-5 countries. In the short run, higher economic growth could reduce life expectancy in most developing countries, particularly Indonesia, the Philippines and Thailand. However, it does not affect the developed country (Singapore). Financial development can help improve life expectancy in Indonesia, the Philippines and Thailand but not Malaysia and Singapore. Energy consumption was found to affect life expectancy in the short run in the Philippines and Thailand only. In other countries, it does not have any significant effect on life expectancy.

5. CONCLUSION

This study visited the impacts of economic growth and financial development upon life expectancy in life expectancy by using the data of ASEAN. This study used panel data over 30 years ranging from 1988 to 2018. We examined the ARDL panel boundary testing

Table 7: Short-Run country specific results

Countries	ECT	lnGDP	lnFD	lnEC	Constant
Indonesia	–0.0749*** (0.000)	–0.0933 *** (0.008)	0.0035** (0.001)	0.0087 (0.014)	0.0752 (0.103)
Malaysia	–0.0068** (0.036)	0.0007 (0.724)	–0.0007 (0.250)	–0.0007 (0.610)	0.0101* (0.087)
Philippines	–0.0616 *** (0.000)	–0.0111** (0.027)	0.0019** (0.026)	0.0043*** (0.002)	0.0630 (0.119)
Singapore	0.0759*** (0.008)	–0.0012 (0.883)	–0.0005 (0.885)	0.0143 (0.179)	–0.0790 (0.213)
Thailand	–0.0368*** (0.000)	–0.0096** (0.043)	0.067*** (0.001)	0.0080*** (0.003)	0.0461** (0.033)

***, ** and * show the significance levels of 1%, 5% and 10%, respectively. The probability values are in parentheses. lnLE represents life expectancy, lnGDP represents GDP, lnFD represents financial development, and lnEC represents energy consumption

approach, applied it to check for cointegration with structural damage that occurred at a specific time using the pooled mean group (PMG) and pooled mean group (MG), as well as we carried out the Hausman test to select the best estimator between PMG or MG, where the two estimators had different assumptions. The findings show that the value of ECT is significantly negative and lower than 1, which means cointegration exists among the variables (life expectancy, economic growth, financial development and energy consumption). In addition, the results of the Hausman Test favor the PMG estimator, indicating that energy consumption can significantly and positively affect life expectancy. This result means that energy diversification in the short run helps increase life expectancy. However, the countries are still extensively dependent on non-renewable energy to generate their economic activities in the long run. Meanwhile, in the short run, higher economic growth can reduce life expectancy in most developing countries, as energy consumption is examined to affect life.

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