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Energy Losses and Effects of Renewable and Non-Renewable Energy Use on Energy Intensity: An Analysis on Malaysia Using Fourier Models

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Abstract

With the globalization process, interactions between developed and developing economies are increasing. With these interactions, the search for common solutions to global problems is increasing. Among the most important global problems are climate change and global warming. Carbon dioxide emissions are among the main determinants of this problem. There are many suggestions on a global scale to reduce carbon dioxide emissions. The environmental dimension is of great importance among the Sustainable Development goals set by the United Nations. The environmental dimension also includes the production and consumption of energy resources. This situation makes energy resources important on a global scale. This study investigates the determinants of energy intensity in the Malaysian economy, which is among the developing countries. In this context, renewable energy, non-renewable energy use, energy losses and energy density variables for the 1990-2020 sample period are used. The Fourier methodology is used as an empirical method in the study. The existence of a long-term relationship between the variables in the empirical model is reached. Empirical results have shown that non-renewable energy use and energy resources increase energy intensity. On the other hand, it has been concluded that the use of renewable energy, known as a clean energy source, is a factor that reduces energy intensity.

Key words: Non-renewable Energy, Renewable Energy, Energy Intensity, Time Series Analysis

JEL Code: C22, O13, Q42

1. Introduction

Economies are divided into developed countries and developing countries according to their level of development. Developing economies are divided into two: emerging economies and economies in the development stage. Emerging economies have a special position in terms of their economic and social potential.

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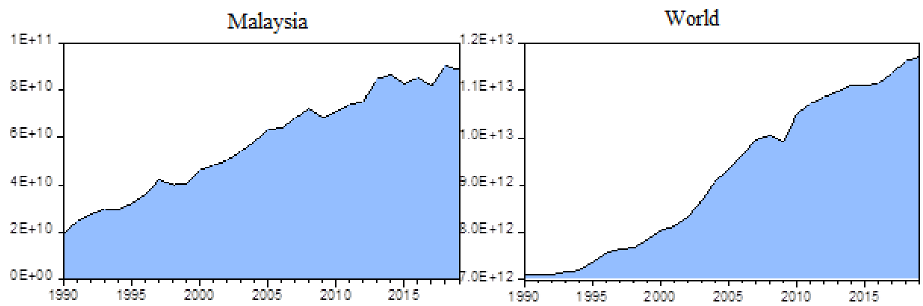
In the 2015 World Economic Report by the IMF, Malaysia, Türkiye, Argentina, Bangladesh, Brazil, Bulgaria, Chile, China, Colombia, Venezuela, Hungary, India, Indonesia, Mexico, Pakistan, Peru, Philippines, Poland, Russia, South Africa, Thailand, Ukraine, and Romania are classified as emerging economies (IMF, 2015: 124). According to FTSE (Financial Times Stock Exchange), emerging economies are divided into two: advanced emerging market economies and secondary market economies. The economies of Brazil, Czechia, Hungary, Malaysia, Poland, South Africa, Taiwan, Mexico, Thailand and Türkiye are classified as advanced market economies, while Pakistan, Egypt, Bangladesh, Colombia, India, United Arab Emirates, Peru, Philippines, Chile, Russia, China and Indonesia are categorized as emerging market economies. The economies of the Emirates are classified as secondary market economies (FTSE, 2015: 2). The Malaysian economy is a special economy that is among the emerging economies that have a special position among the developing countries, as well as being among the advanced market economies in the upper group of the emerging economies.

The Malaysian economy has a special position among advanced market economies. This is because the Malaysian economy is the economy that uses the most fossil fuels among advanced market economies. According to the calculations made by us with the data received from the International Energy Agency (IEA), it was the Malaysian economy that increased its fossil fuel use the most in 2020, with an increase of 390.96% compared to 1990. On the other hand, according to the calculations made by us with the data received from the IEA, world fossil fuel use increased by 64.67% in 2019 compared to 1990, while this increase in the Malaysian economy was 351.98% (IEA, 2021).

Figure 1 shows fossil fuel usage trends for the Malaysian economy and the world between 1990 and 2019.

Figure 1. Fossil fuel use trends (tj)



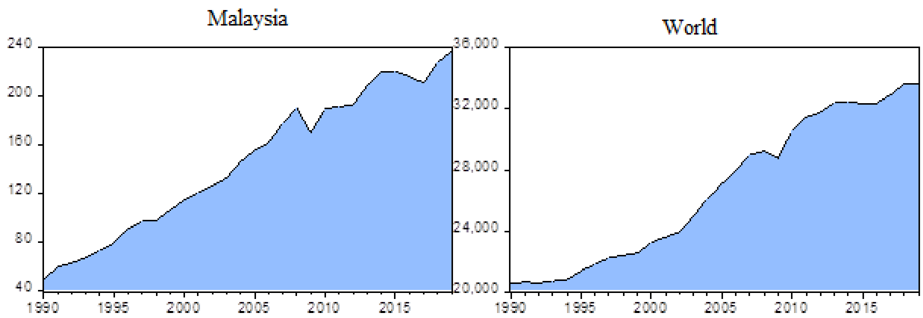
Source: IEA, www.iea.org

If you pay attention to Chart 1, the fossil fuel usage graph of the Malaysian economy has high and sensitive breaks in the relevant period. In addition, while the share of fossil fuel use among the world's total energy resources was 81.43% in 1990, this rate decreased in 2019 and reached 80.88%. For the Malaysian economy, while the proportion of fossil fuel utilization within the total energy resources was

92.55% in 1990, this rate increased in 2019 and reached 96.56% (IEA, 2021). Therefore, the Malaysian economy causes the world fossil fuel usage share outlook to increase. However, improvements in this area will also have a positive impact on the global fossil fuel usage outlook, particularly on the Malaysian economy. Because the Malaysian economy releases a lot of CO_2 emissions, which are harmful to the environment, as a result of the high amount of fossil fuel resources it uses. According to the calculations made by us with the data received from the IEA, world CO_2 emissions increased by 63.92% in 2019 compared to 1990, while this increase in the Malaysian economy was 377.02% (IEA, 2021).

Figure 2 shows CO_2 emission trends resulting from fossil fuel use for the Malaysian economy and the world in the period 1990-2019.

Figure 2. CO_2 emission trends (Mt)



Source: IEA, www.iea.org

If you pay attention to Figure 2, the CO_2 emission graph for the Malaysian economy has a higher, that is, increasing slope, compared to the world CO_2 emission graph. In addition, while the world CO_2 emission increase had an average annual increase rate of 1.66% in the 1990-2019 period, this increase rate was 5.35% annually on average in the Malaysian economy. Therefore, the Malaysian economy is an economy that has a significant increasing effect on the deterioration of the world's environmental quality.

The Malaysian economy exhibits high growth rates, surpassing the global average in terms of both economic expansion and energy outlook. While the average annual increase rate in world economic growth during the 1990-2019 period was 2.91%, this increase rate was 5.42% annually in the Malaysian economy. Therefore, the Malaysian economy stands as one of the pivotal engines of global economic growth.

Figure 3 shows economic growth trends for the Malaysian economy and the world in the period 1990-2019.

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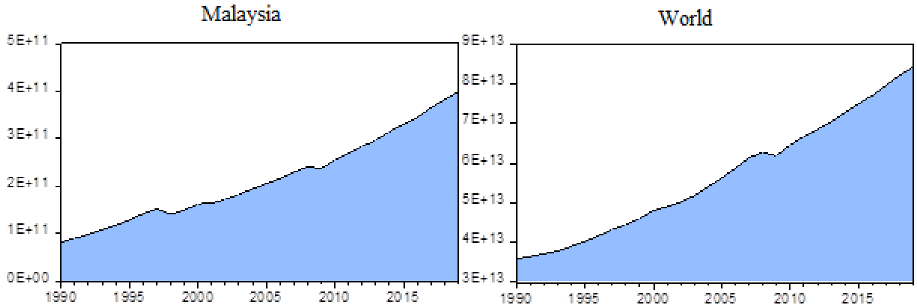
Figure 3. GDP trends (2015 base year US$)

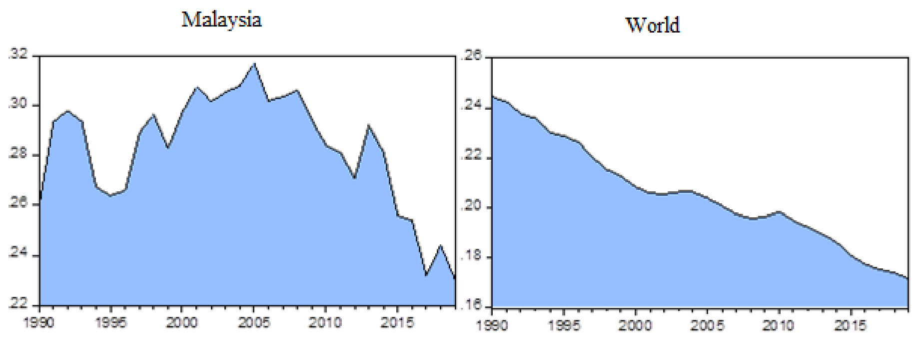


Source: IEA, www.iea.org

According to Figure 3, Malaysian economy and world economic growth have an increasing trend. On the other hand, according to the calculations made by us with the data received from the World Bank, world GDP increased by 136.16% in 2019 compared to 1990, while this increase in the Malaysian economy was 387.71% (World Bank, 2021). Therefore, the Malaysian economy has high growth figures. However, the Malaysian economy achieves this high growth by using high amounts of energy. It is a heavily energy-dependent economy that cannot fulfill its energy requirements with domestic resources and relies on energy imports from abroad. According to calculations made by us with data received from the IEA, the increase in energy imports for the Malaysian economy in 2019 compared to 1990 was 453.64% (IEA, 2021). Therefore, increasing growth for the Malaysian economy brings with it high energy consumption, high energy demand, high fossil fuel use, high CO_2 emissions, high energy imports and high foreign dependency. In other words, the Malaysian economy achieves its high growth figures with a high rate of environmental degradation, in other words, a dirty growth. Increasing dirty growth shows that energy is used intensively in the Malaysian economy. While the world energy intensity, in other words the intensive use of energy, decreased by 29.80% in 2019 compared to 1990, the energy intensity in the Malaysian economy decreased by 11.18%. In other words, while the Malaysian economy achieves growth above the world average in terms of economic growth and energy use, it lags far behind the world average in reducing the intensive use of energy.

Figure 4 shows energy intensity trends for the Malaysian economy and the world in the period 1990-2019.

Figure 4. Energy intensity trends (Total energy use/GDP)



Source: GDP World Data Bank, databank.worldbank.org, Total energy use IEA, www.iea.org

When Figure 4 is examined, it is seen that the world energy intensity generally followed a decreasing trend in the relevant period, but it was high and fluctuating in the form of increases and decreases in the Malaysian economy. Therefore, increasing energy density shows that the energy used per unit output is no longer sufficient compared to before and more energy is now needed. In other words, energy-intensive use increases and energy efficiency decreases. Therefore, this study investigates the opportunities and risks for energy intensity for the Malaysian economy, which is the wheel of global economic growth. The reason for this is that the Malaysian economy is among the advanced market economies, as well as having increases well above the average of world economic growth, world fossil fuel use and world CO_2 emissions. These increases are realized with high amounts of energy imports. Therefore, a reduction in energy-intensive practices (conversely, an increase in energy efficiency) within the Malaysian economy will yield positive effects on both the economic and energy outlook of Malaysia, as well as on the global energy outlook.

Increasing fossil fuel use not only brings costs to foreign-dependent countries in the field of energy, but also threatens a more livable, cleaner and healthier world, especially after the COVID-19 global pandemic. Global carbon emissions have reached unsustainable levels and the use of renewable energy to reduce energy intensity (conversely, increase energy efficiency) has become one of the most important strategies for policy makers (Batley vd., 2001; Bigerna ve Polinori, 2014; Garrett-Peltier, 2017; Ndebele, 2020). The increase in traditional energy usage causes an increase in energy density (conversely, a decrease in energy efficiency) (Fisher-Vanden vd., 2004; Doğan ve Tüzer, 2011; Akal, 2015; Chen vd., 2019). Renewable energy, which is the most important alternative energy source for fossil fuel resources, not only reduces energy intensity (increases energy efficiency), but also increases employment in economies (Bulavskaya and Reynès, 2018), increases environmental quality and ensures sustainable energy and sustainable development (Chen et al., 2019) and offers very important opportunities for economic growth and the development of more efficient technologies (Popp, 2012). Since energy losses do not turn into any output, the decrease in energy losses becomes very important in order to reduce energy intensity (on the contrary, increase energy efficiency) as higher energy losses cause more energy demand and more fossil fuel use. In this context, it becomes important to evaluate energy policies from a broad perspective in terms of general macroeconomic targets. (Abdulkarim, 2023).

In this context, the impact on the use of fossil fuels, renewable energy use and the intensity of energy losses occurring during the production, transmission and transportation of energy for the Malaysian economy in the period 1990-2020 is investigated. In the section following this section, the model, method and findings are presented empirically. Then, inferences are made in the light of the findings and policy recommendations are presented and the study is concluded in this way.

2. Literature Review

Nadel et al. (2004) compiled 11 different studies on energy efficiency and examined US states using periods ranging from 5 to 20 years. As a result of the study, it was found that there was an approximately 1.2% decrease in electricity production with fossil fuels and a 0.5% increase in energy efficiency.

Asif and Muneer (2007) selected five countries (China, India, England, Russia and the USA) among the top seven energy consuming countries in the world and examined them. India, the USA, China and the UK are among the energy importing countries and are dependent on fossil fuels. So much so that an increase in energy efficiency has been observed as a result of the decrease in the use of fossil fuel production. Forecasts regarding the use of renewable energy are presented. Forecasts regarding the use of renewable energy are presented.

Garret-Peltier (2017) discussed the relationship between fossil fuel-based energy production, energy efficiency and employment. It has been found that by shifting fossil fuel-based production to alternative energy sources, every 1 million dollars of investment will have a positive impact on the economy by creating five more jobs in addition to fossil fuel employment, thus reducing energy intensity and increasing energy efficiency.

Mahmood and Ahmad (2018) investigated the correlation between energy intensity and economic growth across 19 selected countries. The study revealed a negative association between energy intensity and growth. Moreover, it was observed that the impacts of energy prices, taxes, and population growth on energy intensity are negative.

Şener and Karakaş (2019), the impact of economic growth on energy efficiency was scrutinized using panel data sets. To explore the long-term relationship, the Westerlund (2007) cointegration test was applied, and coefficient estimation was conducted using the AMG estimator. The relationship between three different income group countries between 1995 and 2016 is discussed. Energy density represented energy efficiency as the dependent variable; As for the independent variables, economic growth, industrial energy intensity and industrial value-added variables representing industrialization were used. A long-term relationship has been established in middle-income group countries, and based on long-term coefficient estimates, it has been discerned that industrialization and economic growth lead to a reduction in energy intensity, thereby increasing energy efficiency. It has been noted that these findings hold true for Hungarian countries.

Fitriyanto and Iskandar (2019) examined the factors affecting energy intensity between 2001 and 2014 for ten countries that are members of the Association of Southeast Asian Nations. Energy density as the dependent variable; GMM method was used with per capita income, per capita energy consumption, energy prices, openness and direct investment variables as independent variables, as well as a period lag of the dependent variable. As a result of the study, while per capita national income and energy prices reduce energy intensity; Energy consumption per person increases. The effect of direct investments and openness to energy intensity was not found to be statistically significant.

Solarin (2020), the relationship between fossil fuel subsidies, per capita income, industry added value and energy intensity variables between 2010 and 2016 for 35 selected developing countries was examined by the GMM method. As a result of the study, it was observed that fossil fuel subsidies increased energy intensity in the short term. In addition, per capita national income has a negative effect on energy intensity; Findings have been obtained that industrialization has a positive effect.

Naimoğlu and Özel (2022) examined energy intensity, non-renewable energy use and GDP variables for the economies of 16 developing countries in the period 1990-2018. As a result of their studies, the use of oil, natural gas and coal increases energy intensity; The utilization of electricity and hydro power has been observed to decrease energy intensity. It has been determined that developed OECD countries have reduced their total energy intensity by reducing the energy consumption of energy-intensive manufacturing industries.

Sun, Jia, Xu, Liu, and Liu (2022), the national density, which defines the total energy intensity and average regional index of 30 emerging market economies for the period 1971-2016 and 1990-2016, was examined. As a result of the study, it was found that national density reduces energy density. Despite the increase in energy prices, the average decline in national density was limited; because it was found that the full value of the negative elasticity between energy prices and national density is less than 7%. It is recommended to implement energy saving policies to achieve the energy efficiency target.

Özbek (2023), the effects of renewable energy, non-renewable energy, urbanization, energy price and industrialization on the energy intensity of 13 energy importer emerging market economies in the period 1990-2018 were tested with PMG, MG, DFE, FMOLS and DOLS methods. It has been found that in the long term, renewable energy use, non-renewable energy use, energy price,

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industrialization and urbanization significantly affect energy intensity in energy importing developing economies. It has been concluded that in the long term, the use of non-renewable energy increases the intensity the most, and the one that decreases it the most is industrialization. So much so that it has been determined that energy prices, renewable energy use and urbanization reduce energy intensity.

Gyamfi, Kwakwa and Adebayo (2023), quantile regression and causality tests were used with the variables of 26 EU countries between 1990 and 2019. As a result of the study, a long-term relationship was obtained between the variables. Findings show that clean energy and income reduce energy intensity, while technological innovations and non-renewable energy increase energy intensity. As a result of causality tests, it was determined that there is a bidirectional causality relationship between energy density and clean energy. It was concluded that there is a unidirectional causality between energy intensity and technological innovation and non-renewable energy.

3. Data and Methodology

In this section, the relationship between energy intensity (lnEY), which is an important indicator of whether energy is used efficiently for the Malaysian economy, and fossil fuel use (lnFOS), renewable energy use (lnYEN) and energy losses that occur during the production, transmission and transportation of energy (lnKYP). will be tested using econometric methods and

$$\text{lnEY}_t = f(\text{lnFOS}_t, \text{lnYEN}_t, \text{lnKYP}_t) \quad (1)$$

will be investigated for the equation in the form.

Data of the Study

In this study, which tests the factors affecting the energy intensity of Malaysia for the period 1990-2020, the dependent variable, energy intensity (lnEY), is taken as total energy use (koe) / GDP ((US$ at 2015 constant prices). The independent variables are fossil fuel use (lnFOS), the sum of coal, oil and natural gas uses (koe), renewable energy use (lnYEN) hydro, solar, wind, etc. The sum of energy resource uses (koe) and energy losses (lnKYP) are taken as the sum of energy losses occurring during the production, transmission and transportation of energy (koe). While GDP data was obtained from the World Bank database, data for other variables were obtained from the International Energy Agency. Natural logarithms of all variables used in the model were taken.

Analysis Method of the Study

In this section of the study, the stationarity of the series will be analyzed using standard ADF and Fourier ADF tests. Subsequently, the investigation will extend to explore the cointegration relationship between the variables. For this purpose, the Fourier ADL cointegration test introduced to the literature by Banerjee et al. (2017) in recent years will be applied. Finally, long-term coefficient estimates will be derived using the Fully Modified Least Squares Method (FMOLS) and Canonical Cointegrated Regression (CCR) tests.

Standard ADF and Fourier ADF Stationarity Tests

Fourier ADF unit root test is a stationarity test developed by Enders and Lee (2012). This test is obtained by adding fourier functions to the traditional ADF test, considering that a series may have structural change. In this way, it is stated that when a series has a structural change in any period, regardless of its number, Fourier functions can take this change into account. For this first

$$\Delta y_t = py_{t-1} + \beta_1 + \beta_2 trendu_t \tag{2}$$

they discussed the traditional ADF test. If you pay attention, no structural change is taken into account in equation (1). In the Fourier ADF test, the model was revised by adding trigonometric functions that can capture structural changes as follows.

$$\Delta y_t = py_{t-1} + \beta_1 + \beta_2 trend + \beta_3 \sin\left(\frac{2\pi kt}{T}\right) + \beta_4 \cos\left(\frac{2\pi kt}{T}\right) + u_t \tag{3}$$

In this context, 't' represents the trend, 'T' denotes time, and 'k' is the frequency value, which is unknown and requires determination. However, the crucial aspect of this test lies in identifying the suitable frequency using MinSSR.

Stationarity tests were performed for the variables, and the results of the tests are presented in Table 1.

Table 1. Results of standard ADF and Fourier ADF unit root tests

	Level					
Variable	**Frequency**	**MİNSSR**	**Appropriate Delay**	**FADF**	**ADF**	**F-Test**
lnEY	1	0.020	0	-1.103	-1.896	7.780**
lnFOS	1	0.007	4	-1.256	-2.180	3.611
lnYEN	1	0.012	4	-3.283	-0.338	1.084
lnKYP	2	0.003	3	-2.238	-2.001	7.781**
	First Difference					
Variable	**Frequency**	**MİNSSR**	**Appropriate Delay**	**FADF**	**ADF**	**F-Test**
lnEY	5	0.021	1	-6.733***	-3.803***	8.300**
lnGLR	1	0.007	3	-5.248***	-6.147***	3.730
lnSNY	1	0.022	0	-4.864	-2.803*	2.008
lnKNT	1	0.002	9	-3.355*	-7.133***	2.799

Note: The critical values for the F test are as follows: 1% = 10.35, 5% = 7.58, 10% = 6.35. For the Fourier ADF with k=1, the critical values are 1% = -4.42, 5% = -3.81, 10% = -3.49. Additionally, the ADF critical values are 1% = -3.753, 5% = -2.998, 10% = -2.639. The notation ***, **, and * indicate that the series are stationary at the 1%, 5%, and 10% significance levels, respectively.

When examining Table 1, it is observed that energy losses exhibit a unit root at level values according to the Fourier ADF test, while other variables show unit roots according to the standard ADF test. On the other hand, the energy density Fourier ADF and other variables exhibit stationarity after being differenced once, as indicated by the standard ADF test.

Cointegration Test

Since the degree of cointegration of all variables is I(1), the cointegration relationship will be investigated with the idea that there may be a long-term relationship between the variables. For this, Banerjee et al. (2017) by placing deterministic components instead of constant terms in the Cointegration Delay Distributed (ADL) test, the Fourier ADL cointegration test was developed as follows.

$$\Delta y_t = d(t) + \beta_1 y_{t-1} + \gamma_1' x_{t-1} + \emptyset' \Delta x_t + u_t \quad (4)$$

$$d(t) = a_0 + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) \quad (5)$$

Here d(t) is the deterministic component. In the revised model, lagged values of the variables were included in the model to eliminate the autocorrelation problem. The main hypothesis tested here is that there is no long-term relationship between the variables. Therefore, to test the long-term relationship, equation (3) is estimated and the appropriate frequency value is obtained and the significance of the lagged value coefficient of the dependent variable is evaluated with the standard t-test.

$$H_0: \beta_1 = 0 \quad (6)$$

It is tested as follows. The test statistics obtained here are from Banerjee et al. (2017)'s article, the decision is made by comparing it with the critical values.

For Malaysia, the cointegration relationship between energy intensity and explanatory variables was examined, and the results are presented in Table 2.

Table 2. FADL cointegration test results

The dependent variable	Delay Length	Frequency	Min AIC	FADL Cointegration Test Statistics
lnEY	2	1	-6.417	-6.516***
lnFOS	4			
lnYEN	4			
lnKYP	3			

Note: Critical values for Fourier ADL cointegration indicate that 1%=-4.66, 5%=-3.94, 10%=-3.57 and ***, **, * values are significant at 1%, 5% and 10% significance levels, respectively.

When Table 2 is reviewed, it is evident that the suitable frequency value for the Fourier ADL cointegration test is 1, and the test statistic exceeds the 1% critical values in absolute terms. Consequently, the null hypothesis, asserting no cointegration between the investigated variables, is rejected. Therefore, it has been found that there is a long-term relationship between energy intensity and explanatory variables for the Malaysian economy.

Estimation of Cointegration Coefficients

After the cointegration relationship between the series is found, long-term coefficient estimation will be made. Long-short and FMOLS developed by Philips and Hansen (1990) and CCR estimators developed by Park (1992), which allow structural changes to be included in the model as dummy variables for long-term coefficient estimation. Period coefficient estimation will be made.

The model revealed a cointegration relationship, and Table 3 presents the results of FMOLS and CCR estimations for the long-term coefficient.

Table 3. Results of long-term coefficient estimation using FMOLS and CCR

lnEY	lnFOS	lnYEN	lnKYP	C
FMOLS	0.096** (0.047)	-0.127*** (0.027)	0.060*** (0.016)	-1.014** (0.422)
CCR	0.094 (0.060)	-0.122*** (0.033)	0.060*** (0.020)	-1.037* (0.542)

Note: Significance levels are *(10%), **(5%), ***(1%).

When Table 3 is examined, FMOLS and CCR results showed similar results. In accordance with both estimators, the increase in renewable energy use (lnYEN) reduces energy intensity, while the increase in fossil fuel use (lnFOS) and energy losses (lnKYP) increases energy intensity.

FMOLS and CCR error correction models were applied in the model for short-term coefficient estimation and the results are shown in Table 4.

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Table 4. Results of short-term coefficient estimation using FMOLS and CCR

ΔlnEY	ECTt-1	ΔlnFOS	ΔlnYEN	lnKYP	C
FMOLS	-0.409*** (0.125)	0.457*** (0.100)	-0.093*** (0.029)	0.022 (0.012)	-0.008 (0.003)
CCR	-0.407*** (0.135)	0.431*** (0.123)	-0.115** (0.048)	0.030 (0.020)	-0.007 (0.004)

Note: Significance levels are *(10%), **(5%), ***(1%).

The error correction coefficient (ECT), representing the long-term relationship between errors, was consistent with theoretical expectations, displaying a negative and statistically significant value. Hence, this affirms the existence of a long-run relationship between economic growth and explanatory variables. The error correction term (ECT) signifies the correction rate, revealing that, according to the FMOLS (-0.409) and CCR (-0.407) models, approximately 0.41% of a deviation from equilibrium in period t-1 will be corrected in period t for both models.

5. Conclusions

The Malaysian economy is among the advanced market economies among the emerging economies in terms of its social and economic potential. However, the Malaysian economy has the highest use of fossil fuels and the highest rate of carbon dioxide emissions resulting from this use among advanced market economies in the 1990-2020 period. Since the increasing use of fossil fuels did not translate into high output in parallel, the Malaysian economy increased energy-intensive use in the relevant period (on the contrary, energy efficiency did not increase at the desired level but decreased). In addition, since the Malaysian economy is an energy importer economy, higher fossil fuel use brings with it more energy demand, more carbon dioxide emissions, more external dependence, more foreign currency need and a more fragile economy. Therefore, a decrease in the energy-intensive use of the Malaysian economy (conversely, an increase in energy efficiency) will further reduce the energy needed for a unit of output, which will lead to a decrease in energy demand, an increase in environmental quality, less external dependence, less foreign exchange need, and less foreign exchange. It is evaluated that it will lead to a current account deficit and a less fragile economy. Therefore, researching energy intensity becomes especially important for the Malaysian economy, which has an important position among the advanced emerging market economies.

In this study, the relationship between energy intensity and variables such as fossil fuel use, renewable energy use, and energy losses considered to influence energy intensity was investigated using annual data for the period 1990-2020 within the Malaysian economy. This study distinguishes itself from the existing literature by being an empirical investigation into the question of how energy intensity can be reduced within the Malaysian economy, which contributes positively to the growth of the global economy with high growth figures and may affect the global environmental quality with high fossil fuel use and high carbon dioxide emission, and what the opportunities and risks are for this situation. is to be investigated as. For this purpose, firstly the stationarity of the variables was investigated. Recently, Banerjee et al. thought that all variables are stationary after taking their first difference, which may indicate a cointegration relationship between the variables. (2017) introduced to the literature, the Fourier ADL cointegration test was used. A cointegration relationship was found between the variables, and FMOLS and CCR estimators were used to determine the magnitude and sign of this relationship. The findings showed that the use of fossil fuels and energy losses increased the energy intensity for the Malaysian economy, but the use of renewable energy decreased the energy intensity. Therefore, while renewable energy offers very important opportunities to reduce the intensive use of energy in the Malaysian economy (conversely, to increase energy efficiency), reducing fossil fuel and energy losses also becomes very important.

In light of the results obtained in the study, policy makers have important duties in the Malaysian economy. Increasing fossil fuel use in Malaysia not only increases energy intensity but also causes deterioration in environmental quality. For this reason, alternative environmentally friendly energy sources are becoming important. In addition, environmentally focused energy policies should be implemented effectively. On the other hand, renewable energy is of paramount importance for achieving sustainable energy practices and fostering sustainable growth by diminishing dependence on foreign energy sources. Simultaneously, it makes substantial contributions to environmental sustainability and the reduction of energy intensity. It will further contribute to the Malaysian economy by increasing Green Sukuk investments used in financing renewable energy resources. Nevertheless, the increase in energy losses increases energy intensity, which shows that the Malaysian economy does not have enough energy efficient technologies, and since increased energy losses do not turn into any output, it increases energy intensity by causing more energy demand. Therefore, reducing energy losses also offers very important opportunities for the Malaysian economy.

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