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Macroeconomic Determinants of Renewable Electricity Technology Adoption in Thailand

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ABSTRACT

Renewable energy plays a significant role in mitigating $C0_2$ emission and boosts sustainable development. Initially, this study examines those factors which create hurdles in adopting renewable energy technology in Thailand. Later, this study examined the impact of renewable energy with other supporting variables on Thailand's total energy consumption. For this purpose, this study used 38 years of data from 1990 to 2018. Initially, the Augmented Dickey fuller test applied to verify the order of integration on indicators, and it confirms that there exists a unit order of integration. Then applied Johansen Cointegration, and it confirms that there are long-run relationships among trade openness, GDP, energy consumption (fossil fuels), financial development, and renewable energy consumption. Further applied Vector error correction model (VECM) to estimates the coefficients on indicators. Results confirm that openness to trade endorses the consumption of renewable energy in Thailand. However, the development of the economy and traditional energy resources creates hurdles to adapting renewable energy in Thailand. Renewable energy technology in Thailand did not significantly impact financial growth and development. After the research, the researcher advised the government of Thailand to adopt and implement the regulations and policies that maximize the magnitude of renewable energy and maximize the portion of renewable energy in total consumption of the overall energy consumption for the country Thailand.

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1. Introduction

Energy consumption in Thailand gradually increased compared to previous periods as the country's economic development increased gradually. Thailand's overall energy consumption is 741.6055 per capita in the year 1990 up to 1976.061 per capita 2018 as per by the (World Bank, 2020) as there is a considerable increase in the overall fundamental consumptions of the energy also overall energy, the emission of carbon because of the energy consumption anticipated to increase gradually. In 2018, Thailand's CO2 – carbon dioxide

emissions because of burning fossil fuels uprisen to 4.552 metric-tons per capita compared to the 1.6055 metric-tons per capita in the year 1990.

As per Thailand's present position as it is one of the largest economies in Asia, there is a boost in economic happenings, and the reserves are predictable to outcome in remarkable growth in the consumptions of overall energy and emissions of the CO2 – carbon dioxide in the upcoming future (Bakhtyar, Kacemi, & Nawaz, 2017; Gertler, Shelef, Wolfram, & Fuchs, 2013). Energy concerning emissions of CO2 – carbon dioxide is significant from all the measures is the intention of it to achieve in-depth growth that is sustainable, and the decarbonization is the boosting part of the renewable energy amongst the overall mix of energy. Although in developed countries such as the E.U., the U.S., and many other developing nations, this has been accomplished significantly, while the adaptation ratio of the renewable energy adoptions in developing countries and adding Thailand is comparatively less. In the current overall scenario, the developing countries and the developed countries want to adopt renewable energy as there are many differences and hurdles. Thus, there is a need to study inclusively to examine the hurdles in adopting renewable energy in growing nations. Contrarily to this circumstantial scenario, this research investigates the constructs of renewable energy consumption in Thailand. There are many pieces of research done on the topic of renewable energies. There is research which is done on empirically indicates the transmission of the technology correspondingly to the GHGs – Green House Gase's extenuation and discovers a minor indication of the influence of FDI – Foreign Direct Investment, trade openness, economic growth and the many other funding resources on the GHGs – Green House Gase's extenuation technology (Peterson, 2008).

The research investigates the relationship between renewable energy technology and developments in the 26-OECD countries of the year, starting from 1991 up to 2004 (Popp, Hascic, & Medhi, 2011). A study investigates the impact of financial segment growth on the technology for the renewable energies growing in-to the non-OECD nations (Brunnschweiler, 2010). Comparative research was done as of Brunnschweiler's research. There examined the dissemination of renewable energy technology by collecting data from the 108 growing nations (Pfeiffer & Mulder, 2013). By collecting data on the consumption of renewable energy from six developing economies of India, China, Brazil, Indonesia, Philippines, and Turkey, and this research examined the persuading constructs of consumption of renewable energy (Muhammad Atif Nawaz, Azam, & Bhatti, 2019; Salim & Rafiq, 2012). This examination collected the data for 65 countries from the year 1990 up to the year 2011.

Furthermore, it concludes that there exists a positive affiliation between energy consumption and the environment and has an inverse relationship among renewable energy and the environment (Omri & Nguyen, 2014). The major influence of this research on available work is three-fold. First of all, there has been a lot of different researches on the energy which produce renewably in the area of ecological economics and energy; the mainstream of the mentioned researches emphasis on industrialized and already developed countries, for example, E.U., United States, and usually the OECD nations (Marques, Fuinhas, & Manso, 2010; Popp et al., 2011).

In contradiction to that, this specific research examined and showcased the variables of adaptation of renewable energy in a developing country such as Thailand. Secondly, most of the research conducted empirically examined the attributes and hurdles to renewable energy utilizing the panel data methods and does not sufficiently integrate the country's particular variables (Muhammad A Nawaz & Hassan, 2016; Omri & Nguyen, 2014; Pfeiffer & Mulder, 2013). The following research has been directed, intensive decarbonization of the requirements by energy systems for the global strategy of the decarbonization and the

separate country-level decarbonization trails SDSN and IDDRI (2014). Correspondingly, independent country physical appearances, such as an endowment of renewable energy, culture, and wealth, are the most significant renewable energy (Menz & Vachon, 2006). The single country trails find essential variations in the deployment of resources, income levels, levels of energy consumption, and structure. Improvement in the technology emitted amounts of the CO2 – carbon dioxide, the structure of the energy market, adaptation and vindication competences, and lastly, the policy targets of growth diagonally the countries. All the indicators mentioned above are taken into contemplation in this research, and the primary emphasis is on the examination of a single country. Lastly, most of the past research on renewable energy utilizes the quantity of energy that is renewably fashioned or disbursed as the dependent variables.

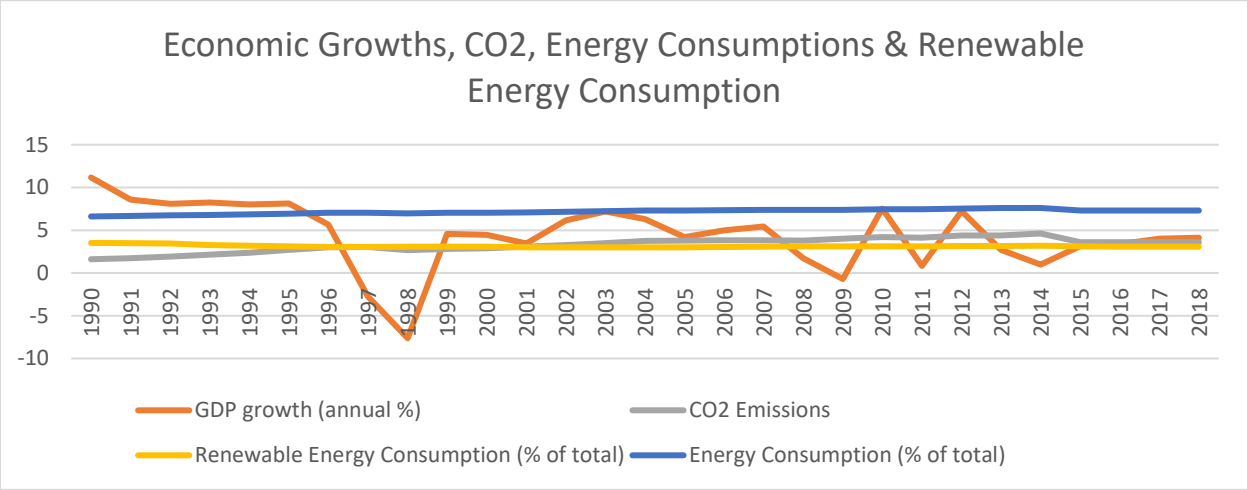
Nevertheless, there it is the portion of the energy which is renewable in the overall consumption of the energy, and it does not utilize the magnitude and the quantity of the energy which is renewably expended, and which is significant for deep decarbonization of the systems of energy and the extenuation of the environmental variations (Aguirre & Ibikunle, 2014). Consequently, this research utilizes the energy, which is renewable in the overall consumption of energy as the dependent indicator – substitution for implementing the electric technology that is renewable. This research's main goal is to regulate the indicators of and the hurdles in an adaptation of renewable energy technology in Thailand by utilizing the data from 1990 up to 2018, showing in Table-1, collected data from WDI – World Development Indicators databases.

Table 1
The Carbon Emissions, The Economic Growths, Renewable Energy and the Energy Consumption

Years	GDP growths (annual %)	CO2 Emissions	Renewable Energy Consumption	Energy Consumption
1990	11.167	1.605	33.639	741.605
1995	8.120	2.709	22.699	1041.311
2000	4.455	2.879	21.988	1148.249
2005	4.187	3.782	20.252	1513.470
2010	7.513	4.195	22.654	1753.702
2015	3.133	3.580	22.863	1460.752
2016	3.356	3.580	21.754	1460.752
2017	4.024	3.580	21.754	1460.752
2018	4.129	3.580	21.754	1460.752

Figure 1 shows the robust linkage between the GDP growth and its impact on the emissions of the Co2 under the overall consumptions of energy and consumptions of renewable energy.

Figure 1
The Economic Growth, CO2, Energy Consumptions and The Renewable Energy Consumptions



2. Literature

In-to the current year's, there has been an adequate examination of the energy that is renewable. Renewable energy is identified as an available opportunity to improve admittance to the energy and, thus, at the central time, alleviate the environmental variations. The investigations on renewable energy indicators could be confidential into time series and panel examination, developing and the developed nations, examinations of the separate variables, and different categories of renewable energy. An examination of renewable energy in the E.U. – European Union, utilized the FEVD – fixed effect vector decomposition procedure on the data collected from 1990 up to 2006 (Marques et al., 2010). Major focusing indicators of research were country-related indicators, political indicators, and socioeconomic indicators, which are distressing renewable energy. Outcomes of the research revealed that the impact of traditional energy resources and the emissions of the CO2 – Carbon Dioxide demoralize renewable obligations. However, minimizing the energy dependence excites the consumption of energy, which is renewable.

An examination of renewable energy consumption, the research is done on the countries that are foremost depositors of renewable energy sectors (Rafiq & Alam, 2010). This research was done by utilizing the 6 developing economies like Turkey, the Philippines, India, Indonesia, Brazil, and China. Moreover, this research deployed the panel techniques of DOLS and FMOLS and ARDL – Autoregressive Distributed Lag. The research outcomes revealed that in countries like Indonesia, Brazil, India, and China, the main drivers of renewables are emissions of pollutants and income levels. In contrast, the income levels appear as the only factor of renewable energy consumption in the Philippines and Turkey countries. Data gathered from the sixty-four countries from the year 1990 up to 2011 inspected the factors affecting renewable energy, the study utilizing dynamic GMM panel technique (Omri & Nguyen, 2014). Out of the sixty-four selected countries, the researchers further developed subpanels of the middle, low and high -income countries. Outcomes of the research revealed that the openness in the trade and the boost in emissions of the (CO2) Carbon-Dioxide are most essential influencers of energy that is renewable into the middle-income levels and the global panels for prices of the oil also have a negative though a minor influence of the energy development which is renewable. Some other researches also

examined the character of individual variable, regulations, and variable in encouraging the adaptations of energy that is renewable in the canvas of various countries (Marques et al., 2010; Menz & Vachon, 2006; Van Rooijen & Van Wees, 2006; Wang, 2006).

In research, there deliver the predictions and the public policy barriers into the promotions of energy that's nature is renewable (Johnstone, Haščič, & Popp, 2010). In research conducted in the same fashion, the researchers shed some light on the significance of the country's strategies and the financial inducements in endorsing renewable energy utilization (Menz & Vachon, 2006). The empirical indications' outcomes revealed that energy sustainability is the most prominent promoter of developing renewable energy (Gan, Eskeland, & Kolshus, 2007). The linkage between the energy prices, the GDP, and the renewable energy examined, and the outcomes revealed that the countries with that of the higher GDP-gross domestic products also have the dimensions to implement renewable resources irrespective of the higher prices them (Chien & Hu, 2008). They have conjectured that high environmental degradations are the necessary inducements of renewable energy development (Sadorsky, 2009b). In a research, it was discussed that the proportion of the conventional resources of the energy such as the fossils fuel into overall consumptions of the energies and it also has possible impacts on-to the developments of renewable energy (Sovacool, 2009).

According to past literature, the adaptation of renewable energy is discussed in detail and the impact examined by the association of GDP levels measuring the income levels. The majority of the research revealed a strong positive and direct association of renewable energy resources' income levels (Huang, Alavalapati, Carter, & Langholtz, 2007; Narayan & Smyth, 2008; Sadorsky, 2009a). Empirical research revealed a minor indication that influences the financial techniques such as the FDI – Foreign Direct Investment, openness to trade, ODA – overseas development assistance, GEF – the global environmental facilities, and the CDM – clean development mechanisms. It improves conditions for the GHGs – greenhouse gases extenuation connected technology (Peterson, 2008). The examination of the factors affecting the patenting activities on renewable energy technology on the paned data from 1991 up to 2004 collected from the twenty-six OECD nations. The research outcomes revealed that the updated knowledge has a very minor but substantial impact on the energy adaptation that is renewable (Popp et al., 2011). Correspondingly, another examination on the development of the financial sectors on renewable energy consumption in non-OECD nations (Brunnschweiler, 2010). In the already available literature, the research amplifies the arrangement of the precise kinds of renewable energy and is also abundant in the already available literature.

Research is done on The United States by implying the variable's data indorsing renewable energy via air (Menz & Vachon, 2006). In an examination of the variable of solar and wind known as the on-farm energy renewable in nature in the U.S. – The United States utilizing the data gathered from the year 2009, solar and wind on-farm energy that is renewable and the adaptation is a twofold selection model (Beckman, Borchers, & Stenberg, 2011). Outcomes of the research revealed that the farmers who have large farms in size and have their living on-farms, and the ones who implement the conservative performs usually report. On the other hand, like renewable energy, the ones who are specialists in row crop manufacturing usually utilize expensive equipment and usually report a minimum. An examination of the forecasted factors of renewable energy in range canons on wind manufacturing development in Michigan, the outcomes revealed that the regulations boost energy development via wind in the U.S. – United States. A study examines the factors of non-hydro energy that is renewable by gathering the data from 108 developing nations utilizing the two-stage approximation techniques (Pfeiffer & Mulder, 2013). Outcomes of the research revealed that the regulatory and economic indicators, democratic and stable governments, higher income levels per capita, and higher school attending levels enhance

the likelihood of the adaptation of energy that is renewable. in contradiction to those researches the institutional regulations aiding programs, production of the high fossil fuels, consumption of the increased electricity, FDI – Foreign-Direct Investment also the openness to trades, demoralize adaptation of energy that is renewable in nature.

The selection of renewable energy in nature regulations and the policies has also drawn consideration in the available literature. There is an investigation of the international and the state variable of the energy renewable in nature regulations in the 112 emerging and developing nations utilizing the panel data ranging from 1998 up to 2009 (Stadelmann & Castro, 2014). The research shed light on the four kinds of regulations, various financial incentives, framework regulations, feed-in-tariffs, and renewable energy in nature goals, and this is utilizing the logit-regression model proceeding in the history prototypical. Outcomes of the research revealed that the national variable, for example, wealth and population, is directly and positively related to the adaptation of the renewable energy regulations, driving the renewable regulations in some of the precise luggage. However, the hydropower sources weaken the adaptation of the goals. Following the international indicators, E.U. membership and colonial effect the adaptation regulations of the energy that are renewable, although, environmental finance instruments, for example, CDM – clean development mechanisms and GEF – global environmental facility only enables the adaptation of the frameworks and targets and they are unsuccessful on the incentives and the tariffs. The rest of the research compiled as chapter 3 is the Methodology and Data, chapter 4 is the Results and Discussions, and the last chapter 5 is Conclusions.

3. Data & Methodology

This study determines the dynamic association between adopting renewable energy (electricity) and determining the drivers and barriers to adopting renewable energy in Thailand. The general model become like this;

REC=f (GDP, TRADE, FINDEV, FUEL)

And the econometric model like,

$$REC = \alpha_o + \alpha_1 GDP_t + \alpha_2 TRADE_t + \alpha_3 FINDEV_t + \alpha_4 FUEL_t + \epsilon_t \quad (1)$$

Where REC = Renewable energy consumptions (% of total final energy consumptions), GDP, = GDP (current US$), TRADE = Trade-in term of imports and exports (% of GDP), FINDEV= financial developments which are measured by the Domestic credits to the private sector, (% of the GDP) and FUEL= consumption of fuels which is measured by the fossil fuels energy consumptions (% of total).

To overcome the heteroscedasticity in the model, we take the natural logarithm of the independent variable. Therefore, equation 1 becomes:

$$logREC = \alpha_o + \alpha_1 logGDP_t + \alpha_2 logTRADE_t + \alpha_3 logFINDEV_t + \alpha_4 logFUEL_t + \epsilon_t \quad (2)$$

3.1 The Vector Error-Correction Method (VECM)

Vector error correction technique (VECM) applied to acquire dynamic relationships amongst equation (2). VECM framework determines the observed variable's causality directions while assigning both the long term and the short-term estimates. The cointegration analysis that is a property of the long-run equilibriums provides information on the long-run

association between variables. Simultaneously, the Granger causality tests, a short-run scenario, provide information on the short-run dynamics period between the variables (Saibu, Omoju, & Nwosa, 2012). Therefore, equation (2) can be explained in the VAR model below:

$$X_t = A_0 + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \beta_3 X_{t-3} + \cdots \ldots + \beta_q X_{t-k} + \varepsilon_t \quad (3)$$

Where X_t is, respectively, GDP, TRADE, FINDEV, and FUEL. Equation 3 can also be written as,

$$X_t = \alpha_0 + \beta_1 \Sigma_{j=1}^{k} X_{t=j} + \varepsilon t \quad (4)$$

VECM form of equation 4 will be,

$$\Delta X_t = A_{o+} \Pi X_{t-1} + \sum_{j=1}^{k} \Gamma_j \Delta X_{t-j} + \epsilon_t \quad (5)$$

3.2 Data Description

The adoption of renewable electricity technology (RES) is represented by the participation of renewable energies in total electricity consumption. Economic development is measure by gross domestic products (GDP) of U.S. dollars. Trade openness (OPEN) is measured by the relationship between trade % of GDP. In other words, it is total trade (import plus export) as the percentage of GDP. The Financial developments (FINDEV) measured by the ratio between credits and the private sectors compared to the gross domestic product; the fossil fuel industry (FUEL) is represented by the participation of fossil fuels in total energy consumption. The data are obtained from (WDI) world development indicators (World Bank, 2020).

4 ` The Results and Discussion

In this portion, we discuss the analysis results and interpret estimated results by appropriate econometrics methodology. First of all, we check the order of integrations of the indicators.

4.1 The Unit-root test

Before analyzing the impeller and the obstacles to adopting renewable electricity technology in Thailand, let us verify the stationary properties of time-series data used in this research.

Table 2
Augment-Unit Root test

	Level		First difference		Order of Integration
Variables	Coef.	Prob.	Coef.	Prob.	
REC	-3.58062	0.3087	-3.58753	0.0077	I(1)
GDP	-3.6032	0.2298	-3.58753	0.0805	I(1)
TRADE	-3.58062	0.8884	-3.59503	0.0008	I(1)
FINDEV	-3.58753	0.3879	-2.97626	0.0625	I(1)
FUEL	-3.58062	0.107	-3.58753	0.0842	I(1)

The Dickey-Fuller test (ADF) is utilized to examine unit root, and results displayed in Table-2 below. From the table, this is observed that all variables are nonstationary at the

levels, but then their first form of difference is stationary. Therefore, we can move on to Johansen's cointegration test.

4.2 Lag selection criteria

According to equation 3, its use to estimate the association amongst renewable electricity technology adoption (log rec) and the GDP (log GDP), openness to trade (log trade), financial developments (log FINDEV) also fossil fuel sources (log fuel). The most used and appropriate techniques are Akaike-Information-Criterion (AIC) and the Schwarz-Bayesian-Information-Criterion (SBIC).

Table 3
VAR-Lag Order Selections Criteria

Lag	LogL	LR	FPE	AIC	SC	H.Q.
0	152.0807	NA	8.40E-12	-11.3139	-11.072	-11.2442
1	283.25	201.7989	2.49E-15	-19.4808	-18.0291	-19.0627
2	309.1957	29.93742	2.94E-15	-19.5535	-16.8922	-18.7871
3	369.197	46.15485*	4.17e-16*	-22.24593*	-18.37486*	-21.13120*

According to table 3, AIC and SBC criteria indicate that the up to lag three is optimal for estimation.

4.3 Johansen Cointegration test

There are two criteria utilized to check the long-run cointegration amongst the equation: the trace test & the other one is the Maximum-Eigenvalue test.

Table 4
Johansen Cointegration test, (trace)

No. of C.E. (s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.797	107.377	69.819	0.000
At most 1 *	0.617	64.365	47.856	0.001
At most 2 *	0.506	38.452	29.797	0.004
At most 3 *	0.390	19.385	15.495	0.012
At most 4 *	0.200	6.022	3.841	0.014

According to table 4, the trace test indicates a 5% significance level. We do not accept the null hypothesis: their exits cointegration in 1, 2, 3 and 4 equations, so; there is cointegration among all the equations. So, this shows that there exists a cointegration amongst renewable energy consumptions and with other exogenous variables.

Table 5
Johansen-Cointegration test (Maximum Eigenvalue)

No. of C.E. (s)	Eigenvalue	Statistics	Critical Value	Prob.**
None *	0.797	43.013	33.877	0.003

At most 1	0.617	25.913	27.584	0.081
At most 2	0.506	19.067	21.132	0.095
At most 3	0.390	13.363	14.265	0.069
At most 4 *	0.200	6.022	3.841	0.014

Johansen cointegration maximum eigenvalues also indicate cointegration in all the equations, which confirms the trace test. Hence, conclude that there is cointegration between renewable energy consumption with other exogenous factors, including GDP, Trade, financial development, and fossil fuel usage.

Table 6
VECM Results

Variables	Coefficients	Std. Error	t-Statistics	Prob.
C	0.000	0.011	-0.038	0.970
CointEq(-1)	-0.701**	0.237	-2.957	0.011
D (LREC(-1))	-0.870*	0.424	-2.051	0.061
D (LREC(-3))	-0.786**	0.355	-2.212	0.046
D (LFINDEV(-1))	0.064	0.099	0.650	0.527
D (LFINDEV(-3))	0.153	0.091	1.679	0.117
D (LFUEL(-1))	-2.727**	1.221	-2.233	0.044
D (LFUEL(-3))	-3.631**	1.160	-3.132	0.008
D (LGDP(-1))	0.230**	0.101	2.269	0.041
D (LGDP(-3))	0.102	0.078	1.302	0.215
D (LTRADE(-1))	0.010	0.101	0.097	0.924
D (LTRADE(-3))	0.063	0.104	0.601	0.558
Model Diagnostics				
R-square				0.720
Adj. R- square				0.483
D.W stat				2.590
LM test				0.129
Breusch-Pagan-Godfrey				0.548

Note: ***, ** and * show 1%, 5% & 10% level of significance correspondingly.

According to the VECM result, the Cointegration term indicates a long-run association amongst renewable energy consumptions with other exogenous variables. This means that if the model moves to an in-equilibrium level, then the model moves to its equilibrium condition with the speed of 70% annually. This is also called the speed of adjustment.

Financial development having an insignificant impact on the adoption of renewable electricity technology in Thailand. This runs counter to expectations as financial development is expected to improve investment in renewable technologies. The result also contradicts (Brunnschweiler, 2010). The insignificant association amongst financial development and the adoption of renewable technology in Thailand could be two key reasons. First, the financial sector in Thailand has been criticized for circumventing long-term development projects' financing due to long recovery periods and high risks (Ogujiuba & Obiechina, 2011).

Renewable technologies are long-term projects with a high level of risks and uncertainties. The situation is also exacerbated by the lack of explicit long-term policies on the Thai government's renewable technologies. Olowojaiye (2013) raised the challenge and risks of financing renewable technology and an electric sector led by the private sector in Thailand. This factor partly explains why the financial sector often looks away from clean energy projects. Secondly, uncertainties about the future of global energy and climate policies often discourage the financial sector from financing climate mitigation projects, as future policies could affect renewable energy projects' feasibility. This argument is based on the (IEA 2005) claim that financial institutions often avoid lending to finance clean energy technology projects because of the uncertainties in the future climate policies & long recovery periods.

The share of fossil fuels in the total energy consumption has significant negative impacts on adopting renewable technology in Thailand; this is known as the lobby effect. This supports the result of (Pfeiffer & Mulder, 2013; Sovacool, 2009). Sovacool (2009) discovers that the lobby-effects of the traditional energy source prevent renewable energy. Similarly, (Pfeiffer & Mulder, 2013) argued that high fossil fuel production appears to lag on renewable energies. The result indicates that the fossil fuels industry also has a significant influence on preventing renewable technology adoption in Thailand. That is understandable given that Thailand is one of the world's largest fossil fuel producers and that the fossil fuel industry provides significant revenue and exchange rates for the government. As a result of this situation, players in the Fossil fuels industry should makes an effort to undermine-measures to promote renewable-energy technology.

Economic development increases the consumption of renewable energy in Thailand. As the economy grows, the ability to adapt the renewable electricity technology is expected to increase, electricity consumption increases. However, renewable energy can also increase in the same proportion as total electricity consumption. In other words, the amount of renewable electricity consumption can increase with economic growth. Further indicates that investments in renewable electricity technology go far beyond economic growth and require deliberate government efforts. This statement is based on the research (Perc & Szolnoki, 2010), which states that economic development could benefit investors and the economy.

The trade-openness was having a significant positive impact on the adoption of renewable electricity technology in Thailand. This result confirms a previous study by (Omri & Nguyen, 2014) that found a positive impact on the trade & foreign-direct-investment (FDI) in renewable-energy. Over the past decade, Thailand has attracted a significant amount of (FDI) foreign direct investment, mainly due to its economic growth in GDP and its large market. Similarly, the import and export trade in Thailand has expanded significantly. Trade opening facilitates the exchange of green goods, services, and technologies and generates human capital opportunities by acquiring skills.

4.4 Diagnostics Test

R-square value is 72%, which means that exogenous variables explained that renewable energy consumption is 72 %, which is quite good, and the Durbin Watson test indicates that the model is a good fit. Applied multiple tests to check the model stability. First, the L.M. test was used to check the autocorrelation problem in the regression, which indicates that we accept the null hypothesis, which means that there does not exist an autocorrelation problem in the regression. Second, we used the Breusch-Pagan-Godfrey test, which is used to check heteroscedasticity problems and results indicate that there is no heteroscedasticity problem in the model.

5 Conclusion

This study examines the drivers and obstacles to adopting electricity technology that is renewable in Thailand using the data from 1990 – 2018, also using the Johansen's-cointegration techniques with the help of the vector-error-correction-model (VECM). This study differs from the previous ones by focusing on the share of renewable energy in total electricity consumption rather than on the amount of renewable energy. The study results present the following results. First, there is a long-term association between adopting renewable-electricity technology and the GDP, trade openness, financial growth, and fossil fuels' participation in total energy consumptions in Thailand. Secondly, the obsession with economic growth and development objectives can undermine the adoption of renewable electricity technology in Thailand. Trade opening significantly promotes the adoption of renewable electricity technology in Thailand. It further allows the diffusions also exchange of ecological goods, services, ideas, and technologies.

Furthermore, financial growth does not have any significant impact on the adoption of renewable-electricity-technology in Thailand. Because the financial sector in Thailand often avoids the financing of long-term projects and the risks and uncertainties about future national and global policies on climate change. Conventional fossil fuels having significant negative impacts on the adoption of renewable technologies.

Based on the results of the study, the following policy suggestion is proposed. First, the Thai government must separate itself from the obsession with economic growth without considering environmental concerns. Therefore, it is necessary to prioritize renewable technology to make sure a low carbon economic development path. Secondly, continuous efforts must be made to open up the economy to improve the import of advanced ecological goods, services, ideas, and technologies. Thirdly, the financial sector would be strengthened to improve its financial investments in clean energy technologies. That would be achieved by providing tools that guarantee the credits assigned to clean energy projects. Fourth, the government must decisively address the influence of the fossil fuels industry lobby in adopting renewable technology. Voluntary measures are needed to significantly decrease fossil fuel consumption, which would be achieved by eliminating subsidies to the Fossil fuels industry and imposing environmental taxes to make renewable energy competitive. Fifth, the government should not only focus on policies that increase the amount of renewable electricity; instead, it should promote policies that would increase the share of renewable energy in total electricity consumption.

Conflict of Interests/Disclosures
The authors declared no potential conflicts of interest w.r.t the research, authorship and/or publication of this article.

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