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Determinants of Carbon Dioxide Emissions in ASEAN 4

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Abstract

Climate change is becoming a serious problem today due to the increase in the earth's surface temperature. environmental damage is the impact of investment, trade, and economic growth processes. We analyzed the relationship between CO2, FDI inflows, trade, and GDP in ASEAN 4 during the period 1970 – 2018 using the Vector Autoregressive (VAR) method. Our results show that the relationship between FDI inflows, trade, and economic growth on CO2 emissions is dependent on each country in ASEAN 4. Therefore, universal policies in the ASEAN region cannot be applied.

Keywords: *Carbon Dioxide Emission; Investment; Trade; Economic Growth.*

Introduction

Climate change is a serious problem at this time, climate change occurs due to an increase in the earth's surface temperature(Wardhono et al., 2016; Q. Zhu & Singh, 2016). The main source of the increase in the earth's temperature comes from fossil fuels which account for 33,890.8 million tons of carbon dioxide emissions globally (BP, 2014). According to The Statistics of the International Energy Agency (IEA) report, carbon dioxide emissions and energy consumption increased annually by 2% from 1997 to 2020. This has an impact on natural ecosystems and sea level rise that can threaten 50% of the world's The impact of climate change and global warming has made countries in the world have made a series of agreements and policies (Kyoto Protocol, Paris Agreement, ASEAN Socio-Cultural Community (ASCC), ASEAN Cooperation on Climate Change) and the G20 agreement (The Group of Twenty Finance Ministers and Central Bank Governos) to reduce greenhouse gas levels (Wardhono *et al*., 2016; Balogh dan Jámbor, 2017; Murshed, 2021). This implies that environmental degradation is the impact of the investment process, trade openness and economic growth of a country (Halicioglu, 2009; Tol, 2009; Lau et al., 2014).

Economic expansion, urbanization and trade openness to increase economic growth have become a concern for policy makers in world countries Studies related to the Environmental Kuznets Curve (EKC) hypothesis, namely the relationship between economic growth and carbon dioxide emissions. The EKC hypothesis is supported by the findings of Ozturk dan Acaravci (2013) in Denmark dan Italia, (Shahbaz et al., 2017) in India, Heidari *et al* (2014) in five countries ASEAN, Lu (2017) in Asia, and

Saboori *et al* (2012) in Malaysia. The economy in a country experiencing rapid industrialization and urbanization will continue to grow and will lead to an increase in carbon dioxide emissions (Nepal et al., 2021) FDI can also be a source of carbon dioxide emissions if the government attracts FDI to stimulate economic activity (Ju et al., 2016; Zhang et al., 2021). However, studies conducted by Aye dan Edoja (2017) found no evidence that economic growth affects carbon dioxide emissions in 31 developing countries. meanhile (Halicioglu, 2008; Karpestam, 2013; Bozkurt and Akan, 2014) found evidence that economic growth does not affect carbon dioxide emissions.

The relationship between FDI and carbon dioxide emissions as an increase in FDI flows results in CO2 emissions through increased energy consumption, it is possible that FDI has the same effect as reducing it. Shahbaz *et al.* (2018) attributing this impact to the "ratchet effect" explaining that increased energy consumption with decreased income is due to the sudden stop of capital flows. Then the relationship between trade and carbon emissions can be explained by the new growth theory (New Growth Theory) which states that open foreign trade policies can affect long-term economic growth through technology. In the new growth model, trade openness can provide access to imported raw materials at lower prices, increase market effectiveness, increase returns on innovation and encourage producers to innovate.

Various studies have been conducted in various countries used as case studies in research to determine and estimate the relationship between FDI and carbon emissions, namely Basu *et al*. (2003); Al-Mulali (2012); Omri et al. (2014); Vo *et al*. (2019); Haug & Ucal (2019); Malik et al. (2020); Essandoh et al. (2021); Zubair et al. (2020) found evidence that FDI inflows have a positive effect on CO2 emissions. This study supports the "pollution haven hypothesis" that developing countries suffer more from environmental pollution caused by multinational companies transferring industries with higher pollution (Copeland & Taylor, 1994). However, research conducted by (Ji & Guo, 2015; Song et al., 2021) found that FDI inflows have a negative relationship to CO2 emissions. This study group supports the "pollution hallo hypothesis" that multinational companies spread their clean technologies to developing countries through the transfer of innovative technologies. Findings Lee, (2013); Chandran & Tang (2013); Shao (2018) that FDI inflows do not harm the environment.

Selanjutnya penelitian mengenai pertumbuhan ekonomi terhadap karbon dioksida dilakukan oleh Acaravci & Ozturk, (2010) using the Auto Regressive Distributed Lag (ARDL) method to find the relationship between economic growth and CO2. The results show that there is a long-term relationship between GDP per capita and CO2 emissions in Switzerland, Portugal, Italy, Iceland, Greece and Denmark. However, findings Kasperowicz, (2015) conducting research on the relationship between economic growth and carbon emissions in 18 European member countries found a negative relationship between economic growth and CO2 emissions (Murshed, 2020; Yuping *et al.*, 2021; Odugbesan dan Adebayo, 2020; Adebayo *et al.*, 2021; Li *et al.*, 2021). Countries in the world have carried out a series of agreements and policies (Kyoto Protocol, Paris Agreement, ASEAN Socio-Cultural Community (ASCC) and ASEAN Cooperation on Climate Change) to reduce greenhouse gas levels (Wardhono *et al.*, 2016; Zhu *et al.*, 2016; Kalmaz dan Ayobamiji, 2020).

The increase in greenhouse gases was also caused by Foreign Direct Investment (FDI) and trade openness (Li et al., 2021; Pao & Tsai, 2010; Zhang et al., 2021). However, FDI and trade openness for developing countries have provided benefits in the development process and economic growth (Wardhono et al., 2020). *The Statistics of the International Energy Agency* (IEA) reports that carbon dioxide emissions and energy consumption increase annually by 2% from 1997 to 2020. The greatest impact of environmental degradation is received by developing countries because they tend to ignore environmental problems (Balogh & Jámbor, 2017; Eriandani et al., 2020).

The ASEAN region is an association of nations in the Southeast Asia region with the majority of developing countries. ASEAN was formed with the aim of cooperation in the economic field. An interesting fact related to ASEAN is that its member countries have high economic growth conditions compared to the average world economic growth and contribute 7.35% of the world's total CO2 emissions (Wardhono et al., 2014; WRI, 2019).

Based on empirical conditions, this study aims to determine the effect of FDI, market openness and economic growth on carbon dioxide emissions in ASEAN-4. This research has a novelty that is different from previous research. First, the previous study only considered imports, exports, and economic growth on carbon dioxide emissions. In this study, we analyze the overall openness of the economy and carbon dioxide emissions. Second, using different analytical tools to have a new perspective on ASEAN-4 countries. This study will assist the government and policy makers in making decisions related to environmental sustainability.

Research Method

The ASEAN region is one of the regions with high economic growth. This economic growth triggers the expansion of natural resources which in turn affects CO2. Countries in ASEAN, such as Indonesia, Malaysia, Thailand and the Philippines are some examples of countries in ASEAN that are oil importing and producing countries. Therefore, the object of this research focuses on ASEAN 4 countries, namely Indonesia, Malaysia, Thailand and the Philippines to analyze the effect of oil price volatility on economic growth. This study uses annual data from the 1970-2018 period obtained from various sources such as the World Bank and other sources.

1. This research uses secondary data in the form of panel data in selected ASEAN from 1970 – 2018 in Indonesia, Thailand, Malaysia and the Philippines. The analysis was carried out starting in 2008 to determine the effect of oil price volatility after the financial crisis and energy crisis. CO2 as the dependent variable. Secondary data sources were obtained from the official website of the World Bank.

The model specifications in this study were adopted from the research conducted Rabindra (2021) added to the institutional characteristics in the country by using economic openness. the specifications of the Rabindra research model (2021) are as follows:

$$\Delta CO2 = \alpha_0 + \beta_1 CO2_{it-1} + \beta_2 FDI_{it-1} + \beta_3 Trade_{it-1} + \beta_3 Trade_{t-1} + \varepsilon_{it}$$

Where CO2 denotes carbon emissions per capita, FDI denotes the flow of FDI per capita, and Trade denotes trade (total exports and imports), GDP denotes real growth per capita, then t denotes the time period and i is the cross section.

Result and Discussion

The results of the VAR analysis show the behavior of each variable FDI, trade openness, and economic growth on carbon dioxide emissions in ASEAN 4. The data stationarity test was carried out in this study using the Augmented Dicky-Fuller (ADF) unit root test. The estimation results show that all variables in ASEAN 4 are stationary at the first different level as indicated by the ADF value < α.

Table 1. Results of the Data Stationarity Test

Indonesia	Prob. CO_2	Prob. FDI	Prob. Trade	Prob. GDP
Level	0.9999	0.0219	0.0082	0.0002
1st *Different*	0.0000	0.0000	0.0000	0.0000
Malaysia	Prob. CO_2	Prob. FDI	Prob. Trade	Prob. GDP
Level	0.9988	0.0110	0.0000	0.2829
1st *Different*	0.0000	0.0000	0.0000	0.0000
Thailand	Prob. CO_2	Prob. FDI	Prob. Trade	Prob. GDP
Level	0.9531	0.0235	0.0023	0.2604
1st *Different*	0.0001	0.0000	0.0000	0.0000
Philipines	Prob. CO_2	Prob. FDI	Prob. Trade	Prob. GDP
Level	0.9996	0.0669	0.0076	0.1789
1st *Different*	0.0060	0.0000	0.0000	0.0000

The cointegration test was carried out to analyze the long-term relationship of the analysis model variables. Thus, if the data is cointegrated, it can be concluded that the data has a long-term relationship or vice versa. In this study, the cointegration test was carried out with Augmented Dicky-Fuller (ADF) and compared the critical value with the trace statistical value. Data can be said to be cointegrated if the trace statistic value > critical value.

Table 2. Result Cointegrasion Test

Countries	A	*Critical Value*	*Trace Statistic*	Kointegrasi
Indonesia	1%	54.68150	53.55964	Tidak Terkointegrasi
	5%	29.79707	26.14673	Tidak Terkointegrasi
	10%	13.42878	11.16059	Tidak Terkointegrasi
Malaysia	1%	54.68150	53.78574	Tidak Terkointegrasi
	5%	29.79707	30.27675	Terkointegrasi
	10%	13.42878	13.74153	Terkointegrasi
Thailand	1%	54.68150	55.06753	Terkointegrasi
	5%	29.79707	19.75526	Tidak Terkointegrasi
	10%	13.42878	5.362394	Tidak Terkointegrasi
Philipines	1%	54.68150	48.54024	Tidak Terkointegrasi
	5%	29.79707	25.40407	Tidak Terkointegrasi
	10%	13.42878	12.06994	Tidak Terkointegrasi

The optimum lag test was carried out to determine the optimum lag value to get the best Vector Autoregressive model in this study. Determining the right lag aims to free the model from autocorrelation problems (Gujarati and Porter, 2009). In addition, the optimum lag test aims to determine the time period vulnerable to the influence of a variable on its past variables and on other endogenous variables. In this study, the determination of the lag used is the Akaike Information Criteria (AIC) because it will provide an additional variable interval to reduce the degrees of freedom. Then according to this, in this study the optimum value chosen is the smallest optimum value. The results of the optimum lag estimation using the Akaike Information Criteria (AIC) method show that the VAR equation in Indonesia has an optimum lag value of 1, Malaysia 1, Thailand 3, and the Philippines 1.

Table 3. Result Optimum Lag Test

Lag	*AIC (Indonesia)*	AIC (Malaysia)	AIC (Thailand)	AIC (Philipines)
0	39.79876	41.23656	39.82638	35.94727
1	34.86148	35.85602	32.99136	31.38574
2	34.94216	36.64756	33.24433	31.94225
3	35.24037	37.40012	32.81375	32.71930
4	35.44600	38.32370	32.89012	33.48173

Impulse Response Function is a VAR stage that aims to see whether there is a shock that occurs from a variable to the present value and future value of the endogenous variables contained in the model (Ronayne, 2011; Neuenkirch, 2013). The Impulse Response for Indonesia is illustrated in Figure 1. The GDP response begins to appear in the first period to the 4th period, then in the 5th to the 20th period FDI is at an equilibrium point and there have not been any shocks or shocks. The trade response in the first period was at the beginning of the period, namely in the 2nd to 4th periods. In the GDP variable responding to CO2 emissions from the first year to the third year, the GDP response to CO2 emissions does not fluctuate and tends to be negative.

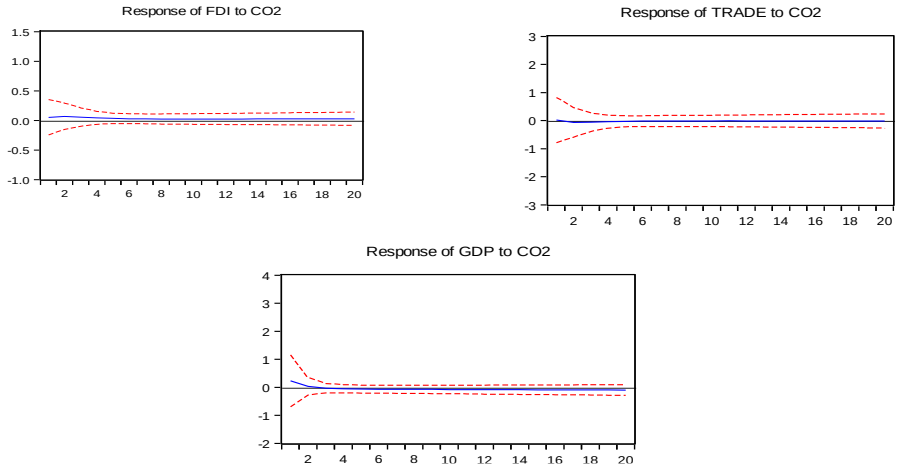

Figure 1. Impulse Response Function Indonesia

The results of the Malaysian Impulse Response Function are illustrated in Figure 2. The results of the Impulse Response Function in Malaysia illustrate that when a shock occurs to FDI, it takes 5 years or more for FDI to return to its equilibrium point. The trade response at the beginning of the period, namely the first year until the 3rd year, then in the 4th year until the 20th year was not too volatile and tended to be negative. The GDP response in the second to fifth periods, then from the fifth to the 20th year tends not to fluctuate and is positive.

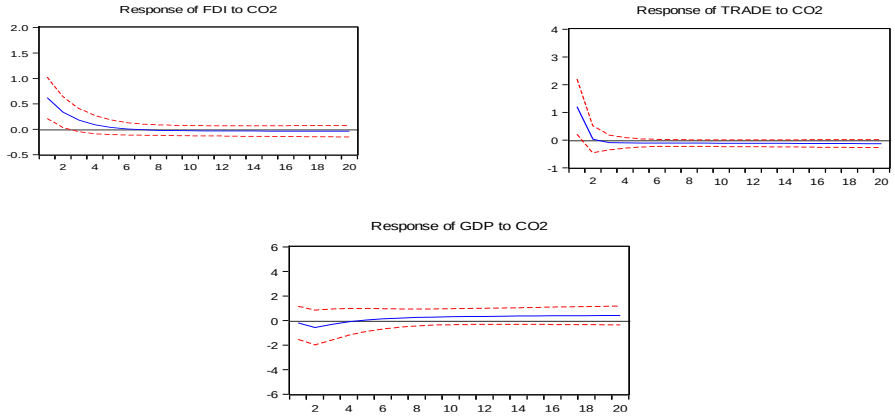

Figure 2. Impulse Response Function Malaysia

The results of the Impulse Response Function in Thailand are depicted in Figure 3. The FDI response in Thailand has fluctuated. In the second year, but in the 4th to 20th year, FDI experienced a positive movement. The trade response also shows a fluctuating movement. In the first year, trade shows a positive response, but in the 2nd to 8th year it shows a negative response, in the 8th to the 12th year, trade is at an equilibrium point and in the 13th to the 20th year again showing negative movement. GDP response in the first year showed a negative movement. However, in the 4th to 10th year it shows a positive movement.

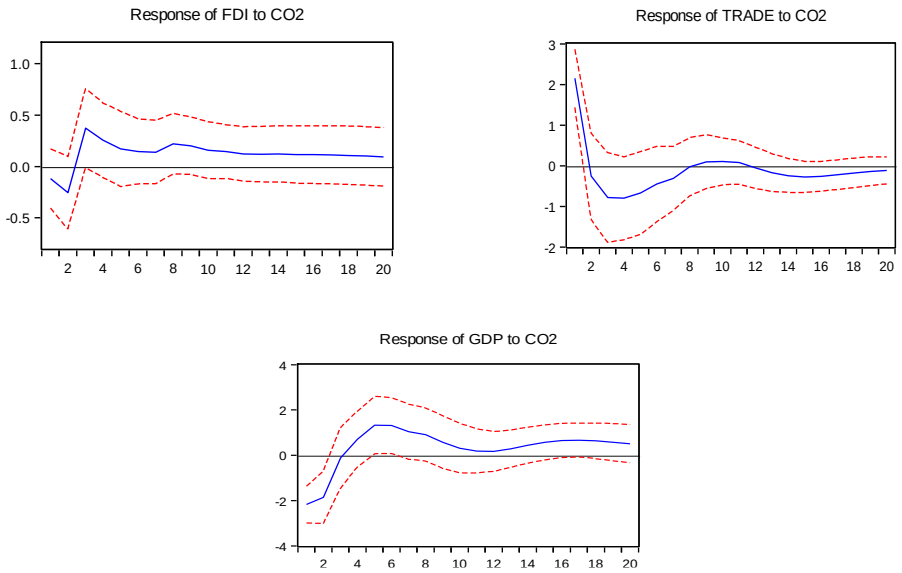

Figure 3. Impulse Response Function Thailand

The results of the Impulse Response Function for the Philippines are depicted in Figure 4. The FDI response for the Philippines tends to be non-fluctuative and has a positive movement. The trade response tends to fluctuate, namely in the first year to the 3rd year it shows a positive movement, but the 4th to the 7th year shows a negative movement, and in the 9th to the 20th year it shows a positive movement. The trade response also showed fluctuation, in the first to the 4th year it showed a positive movement, while the 5th to the 7th year showed a negative movement, then in the 8th to the 20th year it did not fluctuate and showed a positive movement.

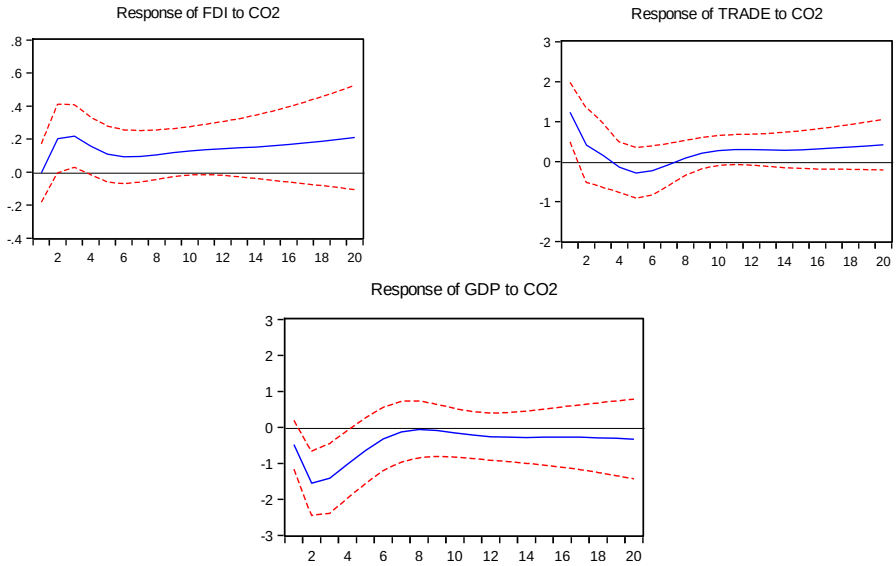

Figure 4. Impulse Response Function Philippines

The Variance Decomposition (VD) test is used to estimate a variable, that is, the difference between before and after the shock comes from the variable itself or other variables (Wardhono et al, 2015). The results of the VD test in Indonesia show that the FDI, Trade and GDP variables contribute to CO2. The FDI variable contributes quite a lot to CO2 with a contribution of 0.000865%, trade contributes to CO2 of 0.873785%, then GDP contributes to CO2 of 0.045798%.

Tabel 4. *Variance Decompotition* Indonesia

Periode	S.E.	CO2	FDI	Trade	GDP
1	14220.80	100.0000	0.000000	0.000000	0.000000
2	20383.54	99.83712	1.55E-05	0.128672	0.034191
3	25278.27	99.66311	0.000180	0.289724	0.046984
4	29538.33	99.52526	0.000379	0.424409	0.049954
5	33409.24	99.42385	0.000532	0.525643	0.049979
6	37017.39	99.34989	0.000633	0.600144	0.049331
7	40438.05	99.29506	0.000697	0.655594	0.048653
8	43720.28	99.25335	0.000739	0.697819	0.048089
9	46898.20	99.22080	0.000767	0.730790	0.047644
10	49996.65	99.19477	0.000788	0.757147	0.047292
11	53034.45	99.17353	0.000803	0.778654	0.047009
12	56026.33	99.15589	0.000815	0.796514	0.046778
13	58984.04	99.14102	0.000825	0.811568	0.046585
14	61917.26	99.12833	0.000834	0.824417	0.046422
15	64834.04	99.11737	0.000841	0.835505	0.046281
16	67741.25	99.10783	0.000847	0.845162	0.046159
17	70644.78	99.09945	0.000852	0.853641	0.046052
18	73549.82	99.09205	0.000857	0.861140	0.045957
19	76460.94	99.08545	0.000861	0.867813	0.045873
20	79382.24	99.07955	0.000865	0.873785	0.045798

The results of the VD test in Malaysia show that the FDI, Trade and GDP variables contribute to CO2. The variable FDI contributes to CO2 with a contribution of 0.411626%, trade contributes to CO2 of 5.47626%, then GDP contributes to CO2 of 3.684356%.

Table 5. Variance Decomposition Malaysia

Period	S.E.	CO2	FDI	TRADE	GDP
1	6721.931	100.0000	0.000000	0.000000	0.000000
2	9475.196	99.17887	0.055721	0.580267	0.185143
3	11658.41	98.21030	0.106564	1.188928	0.494207
4	13562.57	97.24411	0.150708	1.758902	0.846277
5	15295.42	96.33685	0.189051	2.275693	1.198408
6	16910.56	95.51296	0.222249	2.735176	1.529619
7	18439.15	94.77906	0.250909	3.138901	1.831129
8	19901.30	94.13232	0.275625	3.491376	2.100676
9	21310.99	93.56547	0.296959	3.798287	2.339283
10	22678.46	93.06964	0.315411	4.065473	2.549481
11	24011.58	92.63582	0.331422	4.298423	2.734337
12	25316.57	92.25562	0.345366	4.502047	2.896964
13	26598.44	91.92153	0.357562	4.680627	3.040279
14	27861.37	91.62699	0.368275	4.837830	3.166900
15	29108.86	91.36638	0.377729	4.976770	3.279122
16	30343.86	91.13489	0.386108	5.100073	3.378926
17	31568.97	90.92847	0.393568	5.209954	3.468010
18	32786.40	90.74367	0.400239	5.308274	3.547820
19	33998.13	90.57758	0.406228	5.396600	3.619588
20	35205.89	90.42776	0.411626	5.476254	3.684356

The results of the VD test in Malaysia show that the FDI, Trade and GDP variables contribute to CO2. The variable FDI contributes to CO2 with a contribution of 5.857655%, trade contributes to CO2 of 7.977962%, then GDP contributes to CO2 of 0.046476%.

Table 6. ***Variance Decomposition Philipines***

Periode	S.E.	CO2	FDI	TRADE	GDP
1	3455.702	100.0000	0.000000	0.000000	0.000000
2	5925.553	98.47800	0.427319	0.120359	0.974324
3	8035.523	97.26618	1.645871	0.196573	0.891373
4	9892.813	95.48740	2.988611	0.908693	0.615295
5	11577.49	93.41277	4.038849	2.093192	0.455189
6	13164.94	91.52927	4.674836	3.416946	0.378944
7	14714.50	90.08578	4.997124	4.588726	0.328373
8	16271.44	89.10080	5.144033	5.474554	0.280609
9	17868.21	88.46748	5.216373	6.080310	0.235833
10	19524.01	88.05193	5.271993	6.478280	0.197801
11	21247.06	87.74771	5.335989	6.749262	0.167036
12	23039.49	87.49075	5.412277	6.954827	0.142144
13	24902.06	87.25268	5.494458	7.131140	0.121720
14	26836.98	87.02746	5.574075	7.293667	0.104802
15	28848.89	86.81888	5.645093	7.445322	0.090703
16	30944.56	86.63227	5.705061	7.583811	0.078861
17	33132.16	86.47040	5.754351	7.706423	0.068821
18	35420.41	86.33279	5.794819	7.812154	0.060239
19	37818.09	86.21656	5.828643	7.901940	0.052856
20	40333.82	86.11791	5.857655	7.977962	0.046476

The results of the VD test in the Philippines show that the FDI, Trade and GDP variables contribute to CO2. FDI variable contributes quite a lot to CO2 with a contribution of 23.82803%, trade contributes to CO2 of 2.541800%, then GDP contributes to CO2 of 17.02651%

Table 7. Variance Decomposition Thailand

Period	S.E.	CO2	FDI	TRADE	GDP
1	7212.709	100.0000	0.000000	0.000000	0.000000
2	11277.47	95.54798	1.071418	2.731951	0.648650
3	14868.27	94.76576	0.869047	3.748535	0.616659
4	17641.50	92.05392	0.922582	5.393557	1.629940
5	19890.63	88.00763	1.273625	7.048133	3.670615
6	22040.92	84.39826	1.812122	7.260117	6.529505
7	24131.95	80.56505	2.413928	7.015762	10.00526
8	26144.07	77.56391	3.034595	6.403652	12.99785
9	28148.14	75.17336	4.118566	5.609773	15.09831
10	30193.30	73.15053	5.613159	4.879119	16.35719
11	32344.47	71.49819	7.381268	4.264256	16.85629
12	34604.48	69.95456	9.354877	3.768493	16.92207
13	36927.38	68.42211	11.38841	3.370256	16.81922
14	39285.33	66.82612	13.41488	3.053715	16.70529
15	41647.82	65.13190	15.38695	2.807702	16.67345
16	43998.67	63.38357	17.25790	2.628212	16.73033
17	46336.08	61.62029	19.02630	2.514728	16.83868
18	48659.78	59.88246	20.70164	2.465575	16.95033
19	50973.76	58.20436	22.29792	2.477355	17.02036
20	53280.55	56.60366	23.82803	2.541800	17.02651

Conclusion

This study analyzes the relationship between CO2, FDI inflows, trade and GDP in ASEAN 4 during the period 1970 – 2018 using the Vector Autoregressive (VAR) method. In terms of testing in Indonesia, it shows that FDI inflows have a negative effect on CO2 emissions, trade and economic growth have no effect on CO2 emissions. Malaysia gives the result that FDI inflows, trade and economic growth have a positive effect on CO2 emissions. The effect of FDI inflows, trade, and economic growth in Thailand found that FDI inflows and economic growth had a positive effect on CO2 emissions, while trade had a negative effect on CO2 emissions. Then in the Philippines found results that FDI inflows and trade have a positive effect on CO2 emissions, while economic growth has a negative effect on CO2 emissions.

The findings of this study can be used as literacy material for making policies to address the problem of CO2 emissions in various industrial sectors. This article concludes that the relationship between FDI inflows, trade, and economic growth on CO2 emissions depends on each country in ASEAN 4. Therefore, universal policies in the ASEAN region cannot be applied. Along with its advantages, this article has limitations, namely only focusing on countries in ASEAN 5.

Reference

Adebayo, T. S., Kirikkaleli, D., Adeshola, I., Oluwajana, D., Akinsola, G. D., & Osemeahon, O. S. (2021). Coal consumption and environmental sustainability in South Africa: The role of financial development and globalization. *International Journal of Renewable Energy Development*, *10*(3), 527–536. https://doi.org/10.14710/ijred.2021.34982

Balogh, J. M., & Jámbor, A. (2017). Determinants of CO2 emission: A global evidence. *International Journal of Energy Economics and Policy*, *7*(5), 217–226.

BP. (2014). Stratistical Review of World Energy. *Statistical Review of World Energy*, *67*, 1–56. bp.com/statisticalreview

Eriandani, R., Anam, S., Prastiwi, D., & Triani, N. N. A. (2020). The impact of foreign direct investment on CO2 emissions in ASEAN countries. *International Journal of Energy Economics and Policy*, *10*(5), 584–592. https://doi.org/10.32479/ijeep.10230

Ji, Q., & Guo, J. F. (2015). Oil price volatility and oil-related events: An Internet concern study perspective. *Applied Energy*, *137*, 256–264. https://doi.org/10.1016/j.apenergy.2014.10.002

Ju, K., Su, B., Zhou, D., & Zhang, Y. (2016). An incentive-oriented early warning system for predicting the co-movements between oil price shocks and macroeconomy. *Applied Energy*, *163*, 452–463. https://doi.org/10.1016/j.apenergy.2015.11.015

KALMAZ, D. B., & Ayobamiji, A. A. (2020). Reinvestigating the Determinants of Environmental Degradation in Nigeria. *International Journal of Economic Policy in Emerging Economies*, *13*(1), 1. https://doi.org/10.1504/ijepee.2020.10027816

Li, K., Hu, E., Xu, C., Musah, M., Kong, Y., Mensah, I. A., Zu, J., Jiang, W., & Su, Y. (2021). A heterogeneous analysis of the nexus between energy consumption, economic growth and carbon emissions: Evidence from the Group of Twenty (G20) countries. *Energy Exploration and Exploitation*, *39*(3), 815–837. https://doi.org/10.1177/0144598720980198

Murshed, M. (2020). An empirical analysis of the non-linear impacts of ICT-trade openness on renewable energy transition, energy efficiency, clean cooking fuel access and environmental sustainability in South Asia. *Environmental Science and Pollution Research*, *27*(29), 36254–36281. https://doi.org/10.1007/s11356-020-09497-3

Murshed, M. (2021). Can regional trade integration facilitate renewable energy transition to ensure energy sustainability in South Asia? *Energy Reports*, *7*, 808–821. https://doi.org/10.1016/j.egyr.2021.01.038

Nepal, R., Paija, N., Tyagi, B., & Harvie, C. (2021). Energy security, economic growth and environmental sustainability in India: Does FDI and trade openness play a role? *Journal of Environmental Management*, *281*(July 2020), 111886.

https://doi.org/10.1016/j.jenvman.2020.111886
Odugbesan, J. A., & Adebayo, T. S. (2020). The symmetrical and asymmetrical effects of foreign direct investment and financial development on carbon emission: evidence from Nigeria. *SN Applied Sciences*, *2*(12), 1–15. https://doi.org/10.1007/s42452-020-03817-5
Ozturk, I., & Acaravci, A. (2013). The long-run and causal analysis of energy, growth, openness and financial development on carbon emissions in Turkey. *Energy Economics*, *36*, 262–267. https://doi.org/10.1016/j.eneco.2012.08.025
Pao, H. T., & Tsai, C. M. (2010). CO2 emissions, energy consumption and economic growth in BRIC countries. *Energy Policy*, *38*(12), 7850–7860. https://doi.org/10.1016/j.enpol.2010.08.045
Shahbaz, M., Hoang, T. H. Van, Mahalik, M. K., & Roubaud, D. (2017). Energy consumption, financial development and economic growth in India: New evidence from a nonlinear and asymmetric analysis. *Energy Economics*, *63*(76527), 199–212. https://doi.org/10.1016/j.eneco.2017.01.023
Shahbaz, M., Naeem, M., Ahad, M., & Tahir, I. (2018). Is natural resource abundance a stimulus for financial development in the USA? *Resources Policy*, *55*(83280), 223–232. https://doi.org/10.1016/j.resourpol.2017.12.006
Song, W., Mao, H., & Han, X. (2021). The two-sided effects of foreign direct investment on carbon emissions performance in China. *Science of the Total Environment*, *791*, 148331. https://doi.org/10.1016/j.scitotenv.2021.148331
Wardhono, A., Agus, S., & Qoriah, C. G. (2014). Digital Repository Universitas Jember Digital Repository Universitas Jember. *The Effects of European Bilateral Debt Crisis on International Banking Finance Behavior in The Philippines and Indonesia*, *8*(3), 41–51.
Wardhono, A., Putra, P. T. N., & Nasir, M. A. (2016). Causal study of macroeconomic indicators on carbon dioxide emission in ASEAN 5. *Economics and Policy of Energy and the Environment*, *2016*(2), 15–31. https://doi.org/10.3280/EFE2016-002002
Wardhono, A., Qori'ah, C. G., Nasir, M. A., & Aprilia, A. (2020). Analisis Dampak Indikator Makroekonomi terhadap Investasi Portofolio di ASEAN 4. *Jurnal Ekonomi Indonesia*, *9*(1), 81–97. https://doi.org/10.52813/jei.v9i1.43
Yuping, L., Ramzan, M., Xincheng, L., Murshed, M., Awosusi, A. A., BAH, S. I., & Adebayo, T. S. (2021). Determinants of carbon emissions in Argentina: The roles of renewable energy consumption and globalization. *Energy Reports*, *7*, 4747–4760. https://doi.org/10.1016/j.egyr.2021.07.065
Zhang, L., Li, Z., Kirikkaleli, D., Adebayo, T. S., Adeshola, I., & Akinsola, G. D. (2021). Modeling CO2 emissions in Malaysia: an application of Maki cointegration and wavelet coherence tests. *Environmental Science and Pollution Research*, *28*(20), 26030–26044. https://doi.org/10.1007/s11356-021-12430-x
Zhu, H., Duan, L., Guo, Y., & Yu, K. (2016). The effects of FDI, economic growth and energy consumption on carbon emissions in ASEAN-5: Evidence from panel quantile regression. *Economic Modelling*, *58*, 237–248. https://doi.org/10.1016/j.econmod.2016.05.003
Zhu, Q., & Singh, G. (2016). The impacts of oil price volatility on strategic investment of oil companies in North America, Asia, and Europe. *Pesquisa Operacional*, *36*(1), 1–21. https://doi.org/10.1590/0101-7438.2016.036.01.0001
Zubair, A. O., Abdul Samad, A.-R., & Dankumo, A. M. (2020). Does gross domestic income, trade integration, FDI inflows, GDP, and capital reduces CO2 emissions? An empirical evidence from Nigeria. *Current Research in Environmental Sustainability*, *2*, 100009. https://doi.org/10.1016/j.crsust.2020.100009

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