Effect of Foreign Direct Investment and CO2 Emissions on Gross Domestic Product Growth in South Korea

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Abstract:

This study investigates CO2 Emission, The Gross Domestic Product with foreign direct investments. This research investigates data from the 2000 to 2020 starting point to generate "autoregressive vectors" that can be establish connection among the variables. This design was used to analyze co2 emission, The Gross Domestic Product with foreign direct investments on South Korea and we utilize the World Bank's data. We find something about this research, like Foreign Direct Investment is very influential in reducing CO2 Emissions, but CO2 Emissions have a good relationship with Gross Domestic Product, so that if CO2 Emissions increase, Gross Domestic Product will also increase. On the other hand, there is also a gross domestic product that can be increased through foreign direct investment. If the Gross Domestic Product increases, then Foreign Investment will also increase in South Korea.

Background

Over the last century, the concentration of carbon dioxide (CO_2) has increased significantly in our atmosphere, creating many catastrophic effects and environmental impacts (Maniarsu, 2022 ; Krisnanto, 2017). And in the past years, greenhouse gas emissions resulting from their extensive use of fossils fuels have been rising year after year, arising on the an increasingly pronounced greenhouse effect, and Natural catastrophes occurring all over the planet are becoming increasing in frequency (Galvan, Bhatti, Campo, & Trujillo, 2022; Novianto & Prabowo, 2021).

The issue of global warming and energy conservation has placed great pressure on the environment, demanding the long-term sustainability of animal and plant life on our planet. Therefore, it is important to develop strategies to generate hydrogen energy from water and control CO2 emissions by reducing it to a valuable fuel or chemical using solar power (Kirana, Besra, & Chatterjee, 2022; Rusminingsih, 2022). The rise of CO2 emissions corresponds towards the expansion of the population and daily energy use. Every household's energy consumption to meet the requires of life such as the use of electricity consumption (Fitria, Putri, & Retnawaty, 2020). CO2 emissions generated from power plants Calculations involving fossil and quasi fuels there at regional level are required to offer a summary also alternative options during electricity creation with accessible sources (Muchtar, 2019).

Global economic and population growth indicates that global energy consumption will continue to increase. The burning of fossil fuels currently provides about 85% of global energy supply carbon dioxide (CO 2), Methane and other gas emissions (CH 4) also the gas nitrogen dioxide (N 2 O) are released by burning fossil fuels into the atmosphere, as a consequence of

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globalization with Changes in the ecology bring negative consequences to local surroundings with humans (Singla, Devi, & Basu, 2022). Utilization of CO2 is very important to limit the effects of greenhouse gases and manage environmental pollutants in an energy-efficient and economical way (Valluri, Claremboux, & Kawatra, 2022).

The next factor that affects CO2 emissions is Foreign Direct Investment (FDI) (Mahendra, Wahyudi, & Ciptawati, 2022). The ecological effect of foreign foreign direct (FDI) with world trade has recently received a lot of attention (Huang, Chen, Zhu, Huang, & Tian, 2019). Foreign Direct Investment (FDI) is a long-term source of foreign cash that is mostly unaffected by economic upheaval. Almost all Asean members are top direct investment destinations in the globe. If the global economic crisis does not materialize, the quantity of foreign direct investment received varies and tends to rise. The quantity of FDI also has an impact on each nation 's GDP, either overall and by sector. The agriculture industry is one that is affected. The agriculture sector has become one of the areas being evaluated for growth in various ASEAN emerging nations, particularly with the involvement of FDI (Fitria, Astuti, & Susilastuti, 2022; Sasongko, B., Harnani & Bawono, 2022).

The role of foreign investment is to make a real contribution to the economy, technological developments, infrastructure improvements as well as creating jobs and generating state revenues (Violita, Isnainul, Pakpahan, Hadlen, Michael, & Daniel, 2020; Prabowo, Sulisnaningrum, & Harnani, 2021). Economic growth, the rise in the quality or quantity of products and services produced by a country during a certain period based on numerous metrics, such as an increase in wealth, per capita spending, a workforce which is greater than the number of moves (Pratama, 2022; Sulisnaningrum, 2022). Economic growth in an area is certainly increased by several factors such as the effect of an increase in the minimum wage which will certainly affect people's consumption patterns, so that the need for goods and services will increase (Widarni & Laura, 2021; Widarni, 2021). This triggers foreign investors to invest in the area. Economic growth in an area is also supported by long-term investments that can benefit every working community (Kurniawan, Marseto, & Sishadiyati, 2021; Wilantari, Widarni, & Bawono, 2021).

Economic growth is one of the most important indicators in measuring the success of economic development that occurs in a country (Fajriyah, 2022; Purwantini, 2017). Foreign Direct Investment is among the most significant types of international equity flows since it results in indisputable GDP development in developing nations (Kengatharan & Suganya, 2022; Rusminingsih & Damayanti, 2022). The success country in developing its economy is marked by the value and growth rate of gross domestic product (Puspaningtyas & Mukhlis, 2022; Soniansih & Rachman, 2021). Exports can encourage the growth of a country's GDP (Suwali, Putranto, Panunggul, Kinding, & Noviani, 2022; Martasundjaya & Harnani, 2021; Harnani, Prabowo, Alim, & Wulandari, 2022). However, There are several unambiguous elements that influence GDP, such as both inflation and unemployment (Harjunawati & Hendarsih, 2020; Widarni, Febiyana, & Bawono, 2022). This study investigates CO2 Emission, The Gross Domestic Product with foreign direct investments. This research investigates data from the 2000 to 2020 starting point to generate "autoregressive vectors" that can be establish connection among the variables.

Research methods

This model is used to analyze Co2 Emission, Foreign Direct Investment, Gross Domestic Product in South Korea we utilize a secondary data from World Bank. 21 year research study started by the year of 2000 until 2020 was conducted, " vectors's autoregressive " are utilized for express variable one to the other variables connection. We investigate Co2 Emission, Foreign

Direct Investment, Gross Domestic Product in South Korea. To study some connection, we use method regression's multivariate among the variables called Co2 Emission, Foreign Direct Investment, Gross Domestic Product in South Korea :

Table 1. An explanation of the variable description that we will use

Variable	Description
CO2 Emission (CO2EM)	This variable shows that the consumption of liquid fuels related to carbon dioxide emissions mostly refers to emissions from the use of natural gas as an energy source from 2000 to 2020
Foreign Direct Investment (FDIN)	From 2000 to 2020, this variable tracks the foreign capital flows of businesses that moved to or expanded within another country.
Gross Domestic Product (GDP)	This statistic captures the total market value of all commodities and services a nation generated between 2000 and 2020.

$$CO2EM_t = {}_0 + {}_1 FDIN_t + {}_2 GDP_t + e_t \qquad \text{fma 1}$$
$$FDIN_t = {}_0 + {}_1 CO2EM_t + {}_2 GDP_t + e_t \qquad \text{fma 2}$$
$$GDP_t = {}_0 + {}_1 CO2EM_t + {}_2 FDIN_t + e_t \qquad \text{fma 3}$$

Information :
CO2EM : CO2 Emission
FDIN : Foreign Direct Investment
GDP : Gross Domestic Product
e : erroneous title
t : time sequence
β : degree in terms of causation influence
fma: formula

This research employs vector computations, in which every regression connection is combined so that every variable simultaneously becomes both the independent and the dependent variables. The concept of zero from Dickey-Fuller, derived by PP analyze, with p=1 and $\Delta yt = (\rho - 1)yt\text{-}1 + ut$ are formula, while Δ – This is very first try, various operations were utilize. For the "unit root test," the following equation was employed in this study:
$$\Delta Y1 = \alpha_0 + \beta_0 T + \beta_1 Y_{t-1} + \sum_{(i-1)}^{q} \alpha_1 \Delta Y_{t-1} + e_t$$

Caption:
Y are check of unit root variables.
T "linear pattern" variable represented, and "different in lag" are Yt1, 0 are displayed as "single equation," also with "t" being a "time trends" indication. The null hypothesis (h0) and the following are some alternate unit root test hypotheses:
H0 : α=0
H1 : $\alpha \neq 0$

Results and Discussion

Stationarity test that we used to assess whether a data is stationary or not. Term of Error analysis are used for determine if those series is static, including some potential in the event that the

series isn't really stationer. When trying some root of the test unit, some findings are shown at the table 2.

Table 2. The test of ADF's Unit Root on CO2EM, FDIN and GDP data in South Korea.

Variable	Unit Root	Include in the examination Equation	Statistics for the ADF Test	5% Critical Value	Description
CO2 Emission (CO2EM)	Level	Intercept	-1.067474	0.7061	
	First Diff	Intercept	-3.088777	0.0456	Stationer
Foreign Direct Investment (FDIN)	Level	Intercept	-1.716054	0.4060	
	First Diff	Intercept	-7.011476	0.0000	Stationer
Gross Domestic Product (GDP)	Level	Intercept	-4.488868	0.0025	Stationer

CO2EM with FDIN data are stationary on the first diff, when variable GDP are stationer on the original Level. This is demonstrated by Augmented Dickey-Fuller with results like, running the test -3.088777 and probability 0.0456, since the probability is less than 5%, in this situation, the CO2EM First Diff data indicates that it is stationary. Both VAR and causationtry should be tested for sensitivity before starting a VAR investigation, there should be a selection of an acceptable optimal time lag with the results presented in table 3.

Table 3. The test of Optimum Lag at Lag 0 to 4 CO2EM, FDIN and GDP data in South Korea

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-48.17171	NA	0.120431	6.396464	6.541324	6.403882
1	-24.80314	35.05286	0.020635	4.600392	5.179834	4.630064
2	-4.095605	23.29597*	0.005589	3.136951	4.150973	3.188877
3	13.15371	12.93698	0.003155	2.105787	3.554390	2.179967
4	37.74555	9.221942	0.001619*	0.156806*	2.039991*	0.253240*

And the results of the variations in the length of CO2EM, FDIN and GDP lags on the LR, FPE, with SC at position number 1. Some outcome by the three components concludes that lag 4 is different, so lag 4 will be chosen. The VAR analysis's outcome is presented at the table 4.

Table 4. VAR Model Analysis

	CO2EM	FDIN	GDP
CO2EM	0.792447	0.196287	3.963508
	(0.61578)	(1.04623)	(6.43813)
	[1.28690]	[0.18761]	[0.61563]
FDIN	-0.262362	0.012761	7.106899
	(0.67374)	(1.14471)	(7.04414)
	[-0.38941]	[0.01115]	[1.00891]
GDP	-0.229020	0.085593	-2.003441
	(0.14708)	(0.24989)	(1.53773)

	[-1.55714]	[0.34252]	[-1.30285]
C	10.11240	1.427146	-24.33403
	(6.70712)	(11.3956)	(70.1246)
	[1.50771]	[0.12524]	[-0.34701]
R-squared	0.992794	0.863846	0.752197
Adj. R-squared	0.963972	0.319232	-0.239017
Sum sq. resids	0.078234	0.225839	8.551880
S.E. equation	0.161486	0.274371	1.688380
F-statistic	34.44499	1.586161	0.758864
Log likelihood	19.86215	11.38116	-17.69152
Akaike AIC	-0.857769	0.202355	3.836439
Schwarz SC	-0.230040	0.830083	4.464168
Mean dependent	11.30487	0.885659	3.606418
S.D. dependent	0.850774	0.332536	1.516811

The relationship between FDIN and CO2EM, very negative, has -0.262362 the coefficient with the -0.38941 t-statistic. The connection among CO2EM to the GDP are very good, having 3.963508 coefficient with 0.61563 t-statistic, meaning that the more CO_2 Emission the more Gross Domestic Product. Some connection among GDP to the CO2EM are super negative, with -0.229020 coefficient also with -1.55714 t-statistic. From this we can see that if Foreign Investment grows, it can reduce CO_2 Emissions. After doing the VAR test, The test of Causality Granger was carried out with the results presented in table 5.

Table 5. The test of Causality's Granger

Null Hypothesis:	Obs	F-Statistic	Prob.
FDIN does not cause CO2EM	16	3.32203	0.0794
CO2EM does not cause FDIN		0.27824	0.8831
GDP does not cause CO2EM	16	2.47453	0.1395
CO2EM does not cause GDP		1.51434	0.2960
GDP does not cause FDIN	16	1.02269	0.4576
FDIN does not cause GDP		1.96994	0.2038

The outcome test by Granger Causality in South Korea we presented at Table 5. The causal relationship between a single variable and a variable is between the FDIN variable for CO2EM, GDP for CO2EM and GDP for FDIN. This can be seen from the probability that is lower than five percent.

Conclusion

Foreign Direct Investment is very influential in reducing CO_2 Emissions, but CO_2 Emissions have a good relationship with Gross Domestic Product, so that if CO_2 Emissions increase, Gross Domestic Product will also increase. On the other hand, there is also a gross domestic product that can be increased through foreign direct investment. If the Gross Domestic Product increases, then Foreign Investment will also increase in South Korea.

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