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Foreign Direct Investment and CO_2, CH_4, N_2O, Greenhouse Gas Emissions: A Cross Country Study

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ABSTRACT

To investigate the effects of foreign direct investment on CO_2, CH_4, N_2O, and other greenhouse gas emission the study was conducted. The panel data from 200 countries were collected for the period of 1990 to 2018. Ordinary least square (OLS), pooled ordinary least square (POLS), Driscoll-Kraay (DK), Second stage least square (2SLS), generalized methods of moments (GMM) model has been performed. The findings showed that foreign direct investment has positive impact on CO_2 in all the models. The study also showed that FDI had negative impact on CH_4 emission and positive impact on N_2O emissions in all models except GMM model. Finally, FDI had mixed impact on greenhouse gas emission but the results were statistically insignificant except OLS model.

Keywords: CO_2, CH_4, N_2O, Greenhouse Gas emission, FDI
JEL Classifications: F21, O44, Q5

1. INTRODUCTION

The environmental impacts of FDI (foreign direct investment); sustainability of FDI and its effect on the environment; and cross-border environmental implications are the areas of debate in which the FDI-Environment Relationship considers its status for study. The literature has progressed to the point that no clear or conclusive consensus on the meaning has been reached (Cole et al., 2017; Pazienza, 2014), which is particularly true in the first vein of the sentence, for which it is commonly argued that further research is required (Shao, 2018; Zheng and Sheng, 2017; Seker et al., 2015; McAusland, 2010; OECD, 2002a). It has been noted that there has been a greater focus on the relationship between FDI and the atmosphere in this specific thematic area. The majority of the work has been completed, and continues to be done, using various aggregated FDI statistics (e.g. Bakhsh et al., 2017; Shahbaz et al., 2015, 2011; Liang, 2006).

According to Marques and Caetano (2020), the supply of goods and services would begin to rise as a result of globalization, which would inevitably encourage a nation's economic growth. However, one aspect of globalization that has piqued economists' interest is the flow of polluting industries between countries. This issue may be caused by inconsistencies in environmental regulations and the failure of instruments to control pollution. The Panel on Autoregressive Distributed Lag was used to calculate the impact of FDI on carbon dioxide and other significant greenhouse gas emissions with this viewpoint in mind. Their data were collected from 21 countries with different income levels for a period of 2001 to 2017. This approach permitted the study of the resulting emission dynamics in the short and long term.

A deeper understanding of the consequences of FDI flows requires the qualities of efficiency, imagination, and power. Control continues to increase pollution in high-income countries, so it's worth debating more. The Pollution Haven Theory states that FDI reduces emissions in high-income countries while increasing emissions in middle-income countries. However, middle-income countries' willingness to absorb technology will become crucial in the long run. Environmental policy has a major impact on trade in middle-income countries. Our mission is to comprehend the transfer of emissions from polluting industries, which is why we conducted a thorough examination of the industrial sector's total green house gas pollution. It has also been discovered that policymakers do not pay enough attention to how innovation contributes to environmental degradation.

This paper has five sections. Section two discusses the review of the literature. Section three is the methods. Section four is about the findings and discussion and finally section five of this paper give some recommendations and conclusion.

2. LITERATURE REVIEW

While panel data analyses using aggregated data, such as those conducted by Hoffmann et al. (2005), Sadorsky (2010), Pao and Tsai (2011), and Kim and Adilov (2012), have been unable to confirm a near relationship between energy intensity and FDI or emission and FDI, firm level analyses conducted by Blackman and Wu (1999) and Fisher-Vanden et al. (2004) have shown that FDI has a reduced impact on energy intensity. Furthermore, Hoffmann et al. (2005) discover that the causal relationship transfers to country groups that were identified by the Granger Causality Approach screen as having high per capita income. In addition, Eskeland and Harrison (2003), Merican et al. (2007), Lee (2009), Tang (2009), and Chang (2012) have identified a transformation in bilateral relations using time series analyses. Panel data analyses produce more reliable and statistically powerful results than cross-section and time series analyses since the sample size is larger. There may be some variation in the estimated parameters for each particular panel, however (country). Furthermore, the topic of heterogeneity will influence bias estimation. Furthermore, cross-sectional dependence may lead to erroneous conclusions. The chosen panel data approach should then take into account variability and cross-sectional dependency concerns.

Adams (2009) revealed that FDI had an initial negative influence on DI and subsequent positive effect in later periods for the panel of countries investigated. The sign and size of the present and delayed FDI coefficients imply a net crowding out impact. The study's findings and analysis of the literature show that the continent need a tailored strategy to FDI, increased absorption capacity of local companies, and government-MNE cooperation to achieve mutual benefit.

Azomahou et al. (2005) used a panel of 100 nations to look at the empirical relationship between CO_2 emissions per capita and GDP per capita from 1960 to 1996. They discovered evidence of the relationship's structural integrity. They then design a country-specific nonparametric panel data model. The findings of the estimation reveal that the connection is upward sloping.

Another concern in the literature is the conflicting findings on the relationship of FDI-energy power and FDI-pollution. For example, Eskeland and Harrison (2003) found that FDI helps Mexico save electricity. Cole and Elliott's (2005) findings supported the carbon haven hypothesis for the aforementioned countries. Several studies, including Blackman and Wu (1999), Hübler and Keller (2010), Sadorsky (2010), and Herrerias et al. (2013), have assumed that if FDI had contributed to energy production, per capita emissions would have decreased. Variations in processes, time intervals, or factors may have caused conflicting results in various experiments. As a consequence, the two lines of literature should be reviewed together in order to achieve reliable data. If there are contrary results, reducing emissions by energy savings enhanced by inward FDI cannot be obvious.

Muhammad and Khan (2019) contributed to factors that help Asian countries grow economically, with an emphasis on often-forgotten bilateral FDI, electricity use, CO_2 emissions, and a central position in the economy. In their study, they used the Generalized Approach of Moments (GMM), OLS regression, Fixed Effect and Random Effect Estimates. Between 2001 and 2012, data was gathered from 34 Asian host countries and 115 source countries. The study found that oil use, FDI inflows and outflows, CO_2 emissions, and other services all play a significant role in Asia's economic growth. The current study shows that improved energy use strategies, such as the use of appropriate and innovative energy technologies, as well as attracting international investors both in and out of the countries, are being implemented in Asian countries, resulting in increased economic growth as the global economy grows due to both inflows and outflows of FDI, oil use, and CO_2 emissions.

Fauzel (2017) looked at the long- and short-term effects of FDI on CO_2 emissions in Mauritius (disaggregated into manufacturing and non-manufacturing sectors). In this study, the bounds checking approach to co-integration is used. For time series data from 1980 to 2012, the autoregressive distributed lag (ARDL) model is used. The study's main findings show that foreign investment in the manufacturing industry is adverse to the environment, while FDI in non-manufacturing sectors is not. Furthermore, an increase in demand is thought to result in an increase in CO_2 emissions. Energy consumption in the world has already been found to result in an increase in CO_2 emissions. The results also affirm the stability of the model for the small island economy in Mauritius.

Saini and Sighania (2019) focused on long-term growth and carbon emissions, as well as their effect on the environment. They tried to gather all available information on the topic and discovered that, in the present scenario, the problem is gaining high priority due to the growing pace of development in developing countries. Many of the study supported Kuznets' environmental curve theory, and they discovered a wide body of literature advocating for cleaner FDI as a way to reduce the negative environmental effects of economic growth.

Carbon pollution and foreign direct investment have a negative relationship, according to Yüksel et al. (2020). As a result, a comparison analysis is conducted for all E7 and G7 countries. The analysis framework incorporates Pedroni panel co-integration (PPC), Kao panel co-integration (KPC), and Dumitrescu Hurlin panel causality (DHPC) analyses. Gas emissions have a detrimental impact on foreign direct investment for all countries, according to the findings. This bond, on the other hand, is stronger with the G7 economies. There is also no evidence of a causal relationship between these factors. Countries should follow ambitious policies to reduce carbon emissions, according to the experts. In this way, a new tax might be imposed on businesses that emit a lot of pollution. Policymakers, on the other hand, may be willing to support policies that aim to reduce carbon emissions. In this scenario, lowering the tax rate and increasing the supply of technical assistance are examples.

Li and Liu (2011) used absolute and comparative metrics representing the volume of CO_2 released from 30 Chinese provinces from 2000 to 2008 to divide the entire county into eastern and western regions based on economic and geographical factors. The thesis investigates the effect of foreign direct investment on CO_2 emissions across a technical channel. According to the findings, FDI's effect on CO_2 emissions in China is erratic. FDI in the east has a significant positive impact on local CO_2 emissions; the role of FDI in the central region is unclear; and FDI in the west of the country had a negative impact on CO_2 emissions.

The effect of international trade and foreign direct investment (FDI) on CO_2 emissions in Turkey was investigated by Haug and Ucal (2019). They looked at both linear and non-linear ARDL models and discovered that exports, imports, and FDI have a significant asymmetrical effect on per capita CO_2 emissions. FDI, on the other hand, has no statistically significant long-term effects. The reduction in exports reduces per capita CO_2 emissions in the long run, but the increase in exports has no statistically meaningful effect. Imports increase CO_2 emissions per capita, while reductions in imports have no long-term effects. Exports and imports, on the other hand, have little effect on CO_2 power, which measures CO_2 emissions per unit of oil. Instead, financial development and urbanization are aided. They also discovered that the Kuznets environmental curve is current for both CO_2 indices, implying that increases in actual per capita GDP have led to lower CO_2 emissions for at least the last decade, after accounting for other competing causes. Furthermore, in two of the four markets, the sectoral share of CO_2 emissions in total CO_2 emissions asymmetrically changes with foreign trade, with export growth leading to a lower share of CO_2 and imports having the opposite impact. Fereidouni (2013) indicated that actual FDI states do not add to emissions of CO_2. Consumption of energy, urbanization and economic growth has also been described as significant determinants of CO_2 emissions.

Mugableh (2013) and Borhan et al. (2012) studied the association between CO_2 emissions and economic growth in Malaysia in separate ways, but the results were similar: an increase in the economy causes CO_2 emissions. To re-analyse CO_2 pollution, Mugableh (2013) used a self-regressive lag strategy. From 1971 to 2012, data was collected. The results show that economic development is dependent on energy demand, but that this can be harmful to the environment because it can result in CO_2 emissions.

Borhan et al. (2012) used FDI to conduct their research. From 1965 to 2010, they used a larger number of comments in the study. Revenue, FDI, population, exports and imports were included as parts of their CO_2 feature. The non-linear model has been used and the findings suggest that a rise in FDI implies a rise of CO_2 in the atmosphere.

For 15 years, Maddison and Rehdanz (2008) looked at the relationship between GDP and carbon emissions in 134 countries (1990 to 2005). When variability is ignored, CO_2 emissions in North America, Asia, and Oceania are not compared to GDP. Han and Lee (2013) used a hierarchical panel data model to study the directional relationship between pollution and economic growth in OECD countries from 1981 to 2009. The connection between economic growth and pollution implies the need for technological advancement in order to achieve economic growth with minimal pollution, which supports Kuznets' environmental curve hypothesis.

3. METHODS

A analysis using a composite model was carried out. Using STATA 15, describe the relationship between FDI and emission-related variables. The OLS (ordinary least squares) model was used. STATA 15 was used to describe the relationship between FDI and emission variables using the Pooled Ordinary Least Squares (POLS model). Using STATA 15, the Drisc/Kraay (DK) model was used to determine the relationship between FDI and emission variables. The two stage least square model (2SLS) was used to describe the relationship between FDI and variables related to emissions using STATA 15. Finally, using STATA 15, a Generalized Method of Moments (GMM) model was used to define important explanatory variables that can describe the reasons for the interaction between FDI and emission variables.

Variables and Description

Sl. No.	Variable	Description	Unit
1	lnFDI	Log normal of Foreign direct investment, net inflows (BoP, current)	USD
2	$LnCO_2EKT$	Log normal of CO_2 emissions	(kt)
3	$LnCO_2EMTPC$	Log normal of CO_2 emissions	(metric tons per capita)
4	$LnCH_4E$	Log normal of CH_4 emissions	(kt of CO_2 equivalent)
5	LnN_2OE	Log normal of N_2O emissions	(thousand metric tons of CO_2 equivalent)
6	LnTGHGE	Log normal of Total greenhouse gas emissions	(kt of CO_2 equivalent)

Hypotheses

No.	Hypotheses
H_1	A significant positive relationship between FDI and CO_2 emissions (kt) of a country
H_2	A significant positive relationship between FDI and CO_2 emissions (metric ton per capita) of a country
H_3	A significant positive relationship between FDI and CH_4 emissions of a country
H_4	A significant positive relationship between FDI and N_2O emissions
H_5	A significant negative relationship between FDI and total greenhouse gas emissions

4. RESULTS AND DISCUSSION

4.1. Descriptive Statistics

The following table summarizes the informative data for all of the variables considered in this study's models. For each element, the table shows the number of observations, mean value, standard deviations, minimum and maximum score.

Table 1 summarizes the data gathered over a 29-year period for 200 countries on six variables (Appendix 1). The major dependent variable, FDI, shows an average of 17.276 billion dollars for the countries surveyed, with a very high standard deviation of 7.291 billion dollars, indicating that there is a significant difference in FDI among the world's countries. The average $LnCO_2EKT$ is 7.598, while the average $LnCO_2EMTPC$ is 0.554, according to the table. $LnCO_2EKT$ and $LnCO_2EMTPC$ have standard deviations of 4.163 and 1.557, respectively. The average LnCH4E, on the other hand, is 6.57, the average LnN2OE is 5.845, and the average LnTGHGE is 7.458. LnCH4E, LnN2OE, and LnTGHGE have standard deviations of 4.212, 4.007, and 5.122, respectively.

4.2. Pair Wise Correlation Matrix

First, we'll look at the associations among the variables we found in the literature and see whether there's a connection between FDI and different types of emissions. The variables are reported in a combined correlation matrix shown in Table 2.

Table 1: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
LnFDI	5800	17.276	7.291	0	27.879
$LnCO_2EKT$	5800	7.598	4.163	0	16.147
$LnCO_2EMTPC$	5800	0.554	1.557	–4.773	4.249
$LnCH_4E$	5800	6.57	4.212	0	14.376
LnN_2OE	5800	5.845	4.007	-4.155	13.283
LnTGHGE	5800	7.458	5.122	0	16.338

Table 2: Pairwise correlations matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) LnFDI	1.000					
(2) $LnCO_2EKT$	0.306	1.000				
(3) $LnCO_2EMTPC$	0.150	0.344	1.000			
(4) $LnCH_4E$	0.188	0.745	0.018	1.000		
(5) LnN_2OE	0.214	0.727	–0.012	0.982	1.000	
(6) LnTGHGE	0.193	0.702	0.009	0.947	0.940	1.000

Table 2 indicates that the factors have no correlation, suggesting that endogeneity is unlikely. Only the correlation coefficient matrices and collinearity test results are given due to the layout constraints. The findings, on the other hand, pass the correlation coefficient and VIFs tests. Furthermore, both of the variables display importance at the 0.10 mark. There is no correlation between any of the variables at the 0.90 mark.

4.3. Econometric Models

Multiple regression models have been run with the dependent (LnFDI) and independent variables ($LnCO_2EKT$, $LnCO_2EMTPC$, $LnCH_4E$, LnN_2OE and LnTGHGE). In the following section the results of those models are presented and interpreted below.

CO_2 emissions (both kt and metric ton per capita) have a strong positive association with FDI, as seen in Table 3. The higher a country's foreign direct investment, the higher its CO_2 emissions. On the contrary CH_4 emissions has significant negative relationship with the FDI which indicates that a country having high more FDI does not significantly affect the CH_4 emission of a country. N2O emissions and total greenhouse gas emissions have a substantial positive relationship with FDI, indicating that more FDI produces more N2O and total greenhouse gas emissions in a region.

CO_2 emissions (both kt and metric ton per capita) and nitrous oxide emissions (both kt and metric ton per capita) have a strong positive relationship with FDI, as seen in Table 4. The higher a country's foreign direct investment, the higher its CO_2 and N_2O emissions. On the contrary methane emissions has significant negative relationship with the FDI which indicates that a country having high more FDI does not significantly affect the CH_4 emission of a country. Total greenhouse gas emissions have a negative relationship with FDI, but the relationship is insignificant, even though the overall model is significant at the 10% stage.

CO_2 emissions (kt) and nitrous oxide emissions (kt) have a significant beneficial association with FDI, as seen in Table 5. The higher a country's foreign direct investment, the higher its CO_2 and nitrous oxide emissions. Methane emissions, on the other hand, have a substantial negative association with FDI, indicating that a nation with a high level of FDI has no impact on its CH4 emissions. CO_2 emissions (metric ton per capita and gross greenhouse gas emissions) have a favorable relationship with FDI, but the relationship is negligible, despite the overall model

Table 3: Ordinary least squares model

LnFDI	Coef.	St. Err.	t-value	P-value	[95% Conf	Interval]	Sig
$LnCO_2EKT$	0.595	0.037	16.02	0	0.522	0.668	***
$LnCO_2EMTPC$	0.282	0.067	4.21	0	0.151	0.413	***
$LnCH_4E$	–1.715	0.123	–13.95	0	–1.956	–1.474	***
LnN_2OE	1.592	0.12	13.25	0	1.357	1.828	***
LnTGHGE	0.098	0.055	1.78	0.075	–0.01	0.206	*
Constant	13.825	0.192	72.07	0	13.449	14.201	***
Mean dependent var		17.276		SD dependent var		7.291	
R-squared		0.127		Number of obs		5800.000	
F-test		168.958		Prob>F		0.000	
Akaike crit. (AIC)		38726.869		Bayesian crit. (BIC)		38766.862	

***P<0.01, **P<0.05, *P<0.1

Table 4: Pooled ordinary least squares model

Regression results							
LnFDI	**Coef.**	**St. Err.**	**t-value**	**P-value**	**95% Conf**	**Interval**	**Sig**
$LnCO_2EKT$	0.331	0.031	10.64	0	0.27	0.392	***
$LnCO_2EMTPC$	0.817	0.112	7.29	0	0.598	1.037	***
$LnCH_4E$	–0.853	0.155	–5.49	0	–1.157	–0.548	***
LnN_2OE	0.622	0.16	3.89	0	0.308	0.936	***
LnTGHGE	–0.028	0.052	–0.53	0.595	–0.129	0.074	
Constant	16.48	0.305	54.06	0	15.883	17.078	***
Mean dependent var	17.276		SD dependent var			7.291	
Overall r-squared	0.053		Number of obs			5800.000	
Chi-square	282.463		Prob>chi2			0.000	
R-squared within	0.046		R-squared between			0.063	

***P<0.01, **P<0.05, *P<0.1

Table 5: Driscoll-Kraay pooled OLS model

Regression with Driscoll-Kraay standard errors	Number of obs=5800
Method: Pooled OLS	Number of groups=200
Group variable (i): ID	F (5, 28)=53.59
Maximum lag: 3	Prob>F = 0.0000
	R-squared=0.1273
	Root MSE=6.8146

Drisc/Kraay						
LnFDI	**Coef.**	**Std. Err.**	**T**	**P>t**	**95% Conf.**	**Interval**
$LnCO_2EKT$	0.595	0.290	2.050	0.050	0.001	1.190
$LnCO_2EMTPC$	0.282	0.214	1.320	0.199	–0.157	0.720
$LnCH_4E$	–1.715	0.448	–3.830	0.001	–2.632	–0.797
LnN_2OE	1.592	0.450	3.540	0.001	0.670	2.514
LnTGHGE	0.098	0.082	1.200	0.240	–0.069	0.265
_cons	13.825	2.583	5.350	0.000	8.534	19.117

Table 6: Two stage least square model

Instrumental variables (2SLS) regression							
LnFDI	**Coef.**	**St. Err.**	**t-value**	**P-value**	**95% Conf**	**Interval**	**Sig**
$LnCO_2EKT$	0.595	0.037	16.02	0	0.522	0.668	***
$LnCO_2EMTPC$	0.282	0.067	4.21	0	0.151	0.413	***
$LnCH_4E$	–1.715	0.123	–13.95	0	–1.956	–1.474	***
LnN_2OE	1.592	0.12	13.25	0	1.357	1.828	***
LnTGHGE	0.098	0.055	1.78	0.075	–0.01	0.206	*
Constant	13.825	0.192	72.07	0	13.449	14.201	***
Mean dependent var	17.276		SD dependent var			7.291	
R-squared	0.127		Number of obs			5800.000	
F-test	168.958		Prob>F			0.000	

***P<0.01, **P<0.05, *P<0.1

Table 7: Generalized method of moments model

Regression results of system GMM model							
LnFDI	**Coef.**	**St.Err.**	**t-value**	**P-value**	**95% Conf**	**Interval**	**Sig**
L.LnFDI	0.2	0.019	10.50	0	0.163	0.237	***
$LnCO_2EKT$	0.064	0.028	2.30	0.022	0.009	0.118	**
$LnCO_2EMTPC$	0.969	0.182	5.34	0	0.613	1.326	***
$LnCH_4E$	0.83	0.27	3.07	0.002	0.299	1.36	***
LnN_2OE	–1.1	0.3	–3.67	0	–1.689	–0.512	***
LnTGHGE	0.062	0.071	0.88	0.38	–0.077	0.201	
Constant	13.47	0.366	36.85	0	12.753	14.186	***
Mean dependent var	17.438		SD dependent var			7.187	
Number of obs	5400.000		Chi-square			184.165	

***P<0.01, **P<0.05, *P<0.1

being important at the 10% stage. The next model is presented to improve the findings' robustness.

CO_2 emissions (both kt and metric ton per capita) have a strong positive association with FDI, as seen in Table 6. The higher a country's foreign direct investment, the higher its CO_2 emissions. On the other hand, CH4 emissions have a major negative association with FDI, indicating that a nation with a high level of FDI has no impact on its CH_4 emissions. N_2O emissions and total greenhouse gas emissions have a significant beneficial association with FDI, implying that more FDI causes more N2O emissions and total greenhouse gas emissions. The next model is run to ensure that the findings are more reliable.

Table 7 reveals a significant positive association between CO_2 emissions (kt), CO_2 emissions (metric ton per capita), and CH4 emissions and FDI. The higher a country's foreign direct investment, the higher its CO_2 and methane emissions. In the other hand, N2O emissions have a major negative association with FDI, indicating that a nation with a high level of FDI has no impact on its N2O emissions. Total greenhouse gas emissions have a favorable relationship with FDI, but the relationship is negligible, despite the overall model being meaningful at the 10% stage.

5. CONCLUSION

To investigate the effects of foreign direct investment on CO_2, CH_4, N_2O and total greenhouse gas emission this study is conducted. Panel data for 200 countries over a period of 29 years (1990-2018) has been used as the sources of information. Ordinary Least Square (OLS), Pooled Ordinary Least Square (POLS), Driscoll-Kraay (DK), Second Stage Least square (2SLS), Generalized Methods of Moments (GMM) models have been performed and the result shows that there is a positive relationship between FDI and different types of green house gas emission. With economical advancement the emission green house gases (CO_2, CH_4, N_2O and others) increase simultaneously. The findings are very important in case of formulating environmental policies. Therefore, the developing country should find alternative sources of energy to ensure that there is no harmful effect on environment as there is an increase rate of energy consumption with economic growth. The use of natural gas, biomass, green technology etc. may be some important way to reduce CO_2 emission.

Data were collected only from 200 countries because there is a lack of data availability from remaining countries of the world. Data more than 29 years would have led us to a better conclusion. Data conversion during analysis may lead to some discrepancy. Besides these emissions many other variables remained untouched in this research that may help us on finding out other important determinants of FDI.

REFERENCES

Adams, S. (2009), Foreign direct investment, domestic investment and economic growth in Sub-Saharan Africa. Journal of Policy Modeling, 31(6), 939-949.

Azomahou, T., Laisney, F., Van, P.N. (2005), Economic Development and CO_2 Emissions: A Nonparametric Panel Approach. Discussion Paper No 05-56. Netherlands: Elsevier.

Bakhsh, K., Rose, S., Ali, M.F., Ahmad, N., Shahbaz, M. (2017), Economic growth, CO_2 emissions, renewable waste and FDI relation in Pakistan: New evidence from 3SLS. Journal of Environmental Management, 196(1), 627-632.

Bhagwati, J.N. (2007). In Defence of Globalization. New York: Oxford University Press.

Blackman, A., Wu, X. (1999), Foreign direct investment in China's power sector: Trends, benefits and barriers. Energy Policy, 27(12), 695-711.

Borhan, H., Ahmed, E.M., Hitam, M. (2012), The impact of CO_2 on economic growth in Asian. Procedia Social and Behavioral Sciences, 35, 389-397.

Chang, N. (2012), The empirical relationship between openness and environmental pollution in China. Journal of Environmental Planning and Management, 55(6), 783-796.

Cole, M.A., Elliott, R.J.R. (2005), FDI and the capital intensity of "Dirty" sectors: A missing piece of the pollution haven puzzle. Review of Development Economics, 9(4), 530-548.

Cole, M.A., Elliott, R.J.R., Zang, L. (2017), Foreign direct investment and the environment. Annual Review of Environment and Resources, 42, 465-487.

Eskeland, G.S., Harrison, A.E. (2003), Moving to greener pastures? Multinationals and the pollution haven hypothesis. Journal of Development Economics, 70(1), 1-23.

Fauzel, S. (2017), The impact of FDI on CO_2 emission in a small island developing state: A cointegration approach. Economics and Business Letters, 6(1), 6-13.

Fereidouni, H.G. (2013), Foreign direct investments in real estate sector and CO_2 emission. Management of Environmental Quality: An International Journal, 24(4), 463-476.

Fisher-Vanden, K., Jefferson, G.H., Ma, J., Xu, J. (2004), Technology development and energy productivity in China. Energy Economics, 28(5-6), 690-705.

Han, C., Lee, H. (2013), Dependence of economic growth on CO_2 emissions. Journal of Economic Development, 38(1), 47-57.

Haug, A.A., Ucal, M. (2019), The role of trade and FDI for CO_2 emissions in Turkey: Nonlinear relationships. Energy Economics, 81, 297-307.

Herrerias, M.J., Cuadros, A., Orts, V. (2013), Energy intensity and investment ownership across Chinese provinces. Energy Economics, 36, 286-298.

Hoffmann, R., Lee, C.G., Ramasamy, B., Yeung, M. (2005), FDI and pollution: A Granger causality test using panel data. Journal of International Development, 17(3), 311-317.

Hübler, M., Keller, A. (2010), Energy savings via FDI? Empirical evidence from developing countries. Environment and Development Economics, 15(1), 59-80.

Kim, M.H., Adilov, N. (2012), The lesser of two evils: An empirical investigation of foreign direct investment-pollution tradeoff. Applied Economics, 44(20), 2597-2606.

Lee, C.G. (2009), Foreign direct investment, pollution and economic growth: Evidence from Malaysia. Applied Economics, 41(13), 1709-1716.

Li, X.Z., Liu, Z.Y. (2013), Analysis of the effect of FDI on carbon emission of China's manufacturing industry. International Business, 1, 4800.

Li, Z.H., Liu, H.H. (2011), FDI, technology progress and emission of CO_2: Evidence from Chinese provincial data. Studies in Science of Science, 10, 0245891.

Liang, F.H. (2008), Does foreign direct investment harm the host country's environment? Evidence from China. Evidence from China, 2008, 1479864.

Maddison, D., Rehdanz, K. (2008), Carbon Emissions and Economic Growth: Homogeneous Causality in Heterogeneous Panels. FNU Working Paper 163. Fiji: Fiji National University.

Marques, A.C., Caetano, R. (2020), The impact of foreign direct investment on emission reduction targets: Evidence from high- and middle-income countries. Structural Change and Economic Dynamics, 55, 107-118.

McAusland, C. (2010), Globalisation's Direct and Indirect Effects on the Environment. Globalisation, Transport and the Environment. Paris: OECD.

Merican, Y., Yusop, Z., Noor, Z.M., Hook, L.S. (2007), Foreign direct investment and the pollution in five ASEAN nations. International Journal of Economics and Management, 1(2), 245-261.

Mugableh, M.I. (2013), Analysing the CO_2 emissions function in Malaysia: Autoregressive distributed lag approach. Procedia Economics and Finance, 5, 571-580.

Muhammad, B., Khan, S. (2019), Effect of bilateral FDI, energy consumption, CO_2 emission and capital on economic growth of Asia countries. Energy Reports, 5, 1305-1315.

OECD. (2002a), Environmental Benefits of Foreign Direct Investment: A Literature Review, Working Party on Global and Structural Policy. Paris: OECD.

Pao, H.T., Tsai, C.M. (2011), Multivariate granger causality between CO_2 emissions, energy consumption, FDI (foreign direct investment) and GDP (gross domestic product): Evidence from a panel of BRIC (Brazil, Russian Federation, India, and China) countries. Energy, 36(1), 685-693.

Pazienza, P. (2014), The Relationship Between FDI and the Natural Environment. Facts, Evidence and Prospects. Basel: Springer.

Sadorsky P. (2010), The impact of financial development on energy consumption in emerging economies. Energy Policy, 38(5), 2528-2535.

Saini, N., Sighania, M. (2019), Environmental impact of economic growth, emission and FDI: Systematic review of reviews. Qualitative Research in Financial Markets, 11(1), 81-134.

Say, N.P., Yucel, M. (2006), Energy consumption and co2emissions in Turkey: Empirical analysis and future projection based on economic growth. Energy Policy, 34, 3870-3876.

Seker, F., Ertugrul, H.M., Cetin, M. (2015), The impact of foreign direct investment on environmental quality: A bounds testing and causality analysis for Turkey. Renewable and Sustainable Energy Review, 52, 347-356.

Shah, H.S., Mohsin, H.A., Qazi, M. (2016), The nexus between sectoral FDI and institutional quality: Empirical evidence from Pakistan. Applied Economics, 48(17), 1591-1601.

Shahbaz, M., Nasreen, S., Afza, T. (2015), Does foreign direct investment impede environmental quality in high-, middle-, and low-income countries? Energy Economics, 51, 275-287.

Shao, Y. (2018), Does FDI affect carbon intensity? New evidence from dynamic panel analysis. International Journal of Climate Change Strategies and Management, 10(1), 27-42.

Tang, C.F. (2009), Electricity consumption, income, foreign direct investment, and population in Malaysia: New evidence from multivariate framework analysis. Journal of Economic Studies (Glasgow, Scotland), 36(4), 371-382.

World Bank. (2009), Implementing Agriculture for Development. Agriculture Action Plan 2010-2012. Washington, DC, USA: World Bank.

Yüksel, S., Dinçer, H., Karakuş, H., Ubay, G.G. (2020), The negative effects of carbon emission on FDI: A comparative analysis between E7 and G7 countries. In: Handbook of Research on Sustainable Supply Chain Management for the Global Economy. United States: IGI Global. p20-35.

Zheng, J., Sheng, P. (2017), The impact of foreign direct investment (FDI) on the environment: Market perspectives and evidence from China. Economies, 5(8), 2-15.

APPENDIX

Appendix 1: List of countries

1	Afghanistan	41	Congo, Dem. Rep.	81	Hong Kong SAR, China
2	Albania	42	Congo, Rep.	82	Hungary
3	Algeria	43	Costa Rica	83	Iceland
4	American Samoa	44	Cote d'Ivoire	84	India
5	Andorra	45	Croatia	85	Indonesia
6	Angola	46	Cuba	86	Iran, Islamic Rep.
7	Antigua and Barbuda	47	Cyprus	87	Iraq
8	Argentina	48	Czech Republic	88	Ireland
9	Armenia	49	Denmark	89	Isle of Man
10	Aruba	50	Djibouti	90	Israel
11	Australia	51	Dominica	91	Italy
12	Austria	52	Dominican Republic	92	Jamaica
13	Azerbaijan	53	Ecuador	93	Japan
14	Bahamas, The	54	Egypt, Arab Rep.	94	Jordan
15	Bahrain	55	El Salvador	95	Kazakhstan
16	Bangladesh	56	Equatorial Guinea	96	Kenya
17	Barbados	57	Eritrea	97	Kiribati
18	Belarus	58	Estonia	98	Korea, Dem. People's Rep.
19	Belgium	59	Eswatini	99	Korea, Rep.
20	Belize	60	Ethiopia	100	Kosovo
21	Benin	61	Euro area	101	Kuwait
22	Bermuda	62	Fiji	102	Kyrgyz Republic
23	Bhutan	63	Finland	103	Lao PDR
24	Bolivia	64	France	104	Latvia
25	Bosnia and Herzegovina	65	French Polynesia	105	Lebanon
26	Botswana	66	Gabon	106	Lesotho
27	Brazil	67	Gambia, The	107	Liberia
28	Brunei Darussalam	68	Georgia	108	Libya

(Contd...)

Appendix 1: ***(Continued)***

29	Bulgaria	69	Germany	109	Liechtenstein
30	Burkina Faso	70	Ghana	110	Lithuania
31	Burundi	71	Gibraltar	111	Luxembourg
32	Cabo Verde	72	Greece	112	Macao SAR, China
33	Cambodia	73	Greenland	113	Madagascar
34	Cameroon	74	Grenada	114	Malawi
35	Canada	75	Guatemala	115	Malaysia
36	Chad	76	Guinea	116	Maldives
37	Chile	77	Guinea-Bissau	117	Mali
38	China	78	Guyana	118	Malta
39	Colombia	79	Haiti	119	Marshall Islands
40	Comoros	80	Honduras	120	Mauritania
121	Mauritius	161	Singapore		
122	Mexico	162	Slovak Republic		
123	Micronesia, Fed. Sts.	163	Slovenia		
124	Moldova	164	Solomon Islands		
125	Mongolia	165	Somalia		
126	Morocco	166	South Africa		
127	Mozambique	167	South Asia		
128	Myanmar	168	Spain		
129	Namibia	169	Sri Lanka		
130	Nauru	170	St. Kitts and Nevis		
131	Nepal	171	St. Lucia		
132	Netherlands	172	St. Vincent and the Grenadines		
133	New Caledonia	173	Sudan		
134	New Zealand	174	Suriname		
135	Nicaragua	175	Sweden		
136	Niger	176	Switzerland		
137	Nigeria	177	Syrian Arab Republic		
138	North America	178	Tajikistan		
139	North Macedonia	179	Tanzania		
140	Norway	180	Thailand		
141	Oman	181	Timor-Leste		
142	Pakistan	182	Togo		
143	Palau	183	Tonga		
144	Panama	184	Trinidad and Tobago		
145	Papua New Guinea	185	Tunisia		
146	Paraguay	186	Turkey		
147	Peru	187	Turkmenistan		
148	Philippines	188	Uganda		
149	Poland	189	Ukraine		
150	Portugal	190	United Arab Emirates		
151	Qatar	191	United Kingdom		
152	Romania	192	United States		
153	Russian Federation	193	Uruguay		
154	Rwanda	194	Uzbekistan		
155	Samoa	195	Vanuatu		
156	Sao Tome and Principe	196	Venezuela, RB		
157	Saudi Arabia	197	Vietnam		
158	Senegal	198	Yemen, Rep.		
159	Seychelles	199	Zambia		
160	Sierra Leone	200	Zimbabwe		