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Article

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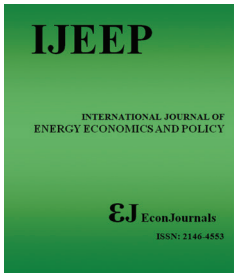

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The Effects of Economic Integration on Co_2 Emission: A View from Institutions in Emerging Economies

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ABSTRACT

CO_2 emission are seen as an urgent problem in emerging economies because these countries are in the process of economic growth, trade liberalization and receiving foreign investment at a rapid rate, which puts pressure on the environment or causes pollution if not strictly controlled. This article examines the relationship between economic openness (free trade and foreign direct investment inflows) on CO_2 emission under the influence of institution in these countries. The study mentions some hypotheses of "pollution heaven" or "pollution halo" as well as presents hypotheses related to environmental problems such as Kuznets environmental curve theory and STIRPAT model.

Keywords: Economic Openness, CO_2 Emission and Institution
JEL Classifications: C33, F15, Q56

1. INTRODUCTION

The degradation of environmental quality is considered an important problem that humankind has been facing in the 21st century (Mert and Caglar, 2020). According to the National Oceanic and Atmospheric Administration (NOAA), the greenhouse effect is the main cause of environmental degradation as CO_2 emission have increased from 280 ppm (pre-industrial period in the early 18th century) to more than 400 ppm at present (Mert and Caglar, 2020; Butler and Montzka, 2019; Boden et al., 2009). Carbon Dioxide (CO_2) emission is assessed as a major factor causing environmental pollution (Mert and Caglar, 2020; Cai et al., 2018). Also in the annual report of McKinsey (2020), climate change scholars use CO_2 concentration in various scenarios to measure pollution emission through the Representative Concentration Pathway (RCPs) scale with 4 RCP scenarios (RCP2.6, RCP4.5, RCP6.0, and RCP8.5). Therefore, many studies confirmed the increasing clearness of relationship between environmental pollution (EP) factor and economic activities (United Nations Conference on Trade and Development - UNCTAD, 2019; Center for Global Development, 2015; Zakarya et al., 2015) when economic activities contribute to the greenhouse effect (Spangenberg, 2007).

One of which were the studies on the factors of trade liberalization and foreign direct investment (FDI) that impact on the environment through capital shifts, technology from developed countries to emerging economies (Kahouli and Omri, 2017; Haapanen and Tapio, 2016; Ertugrul et al., 2016; Grossman and Krueger, 1991). These shifts may be the transfer of old and outdated technologies that pollute the environment to developing or underdeveloped countries in accordance with the polution-haven hypothesis (Zakarya et al., 2015; Peters et al., 2011; Peters and Hertwich, 2008). On the contrary, this economic integration also created opportunities for countries to receive capital and new technologies from developed countries to improve and replace old and outdated technologies for limiting and reducing CO_2 emission in the environment or contributing to increasing people's income, helping them change the perception of the importance of the environment in economic development, equivalent to "pollution halo" hypothesis (Frankel and Rose, 2002; Wheeler, 2001).

This study would test (i) two above research hypotheses, (ii) relationship between economic growth and CO_2 emission with a consideration to the influence of institutional quality factors in these emerging economies (Nguyen et al., 2018; Ertugrul et al., 2016; Zakarya et al., 2015; Marošević and Jurković, 2013; North, 1990).

2. OVERVIEW OF RELEVANT THEORIES AND EMPIRICAL RESEARCH

2.1. Some Theories about Economic Integration and Environment

2.1.1. Theoretical basis of CO_2 emission and environmental pollution

According to the United Nations Framework Convention (1992) on Climate Change (UNFCCC), climate change is the change of the climate, is regulated directly or indirectly based on human activities changing atmospheric composition and making additional contributions to the observed natural climate variability in a comparable period of time. The high correlation between three environmental pollutants (CO2, NO and SO_2) provided evidence that the use of CO_2 was a representative to measure pollution level (Hoffmann et al., 2005). Next, CO_2 emission was considered to be the main cause of the greenhouse effect (Haapanen and Tapio, 2016; Talukdar and Meisner, 2001) when global energy-related carbon emission increased 1.7% in 2018, the highest increase rate since 2013 (IEA, 2018). In emerging economies, CO_2 content per capita was 1.75 times higher than that of the world, proving that the pollution level in this area was higher than the world average (Nguyen et al., 2018) or developing countries were emitting 63% of CO_2 volume into the environment (Center for Global Development, 2015) but this rate had been gradually stabilizing in developed countries (UNCTAD, 2019).

2.1.2. Theoretical basis for foreign direct investment

According to IMF (1993) and OECD (1996), FDI was a form of international investment that reflects the objectives of entities residing in a n economy with long-term interest in another stable and long term country. According to the Kyoto Protocol (1997), FDI was an important capital inflow to help developing countries grow economically and narrow the gap in technical qualifications with developed countries. Wang and Wan (2008) said that FDI inflow played an important role in contributing to economic growth and trade surplus in China (1979 - 2007). FDI was also considered as a strategic capital to promote economic growth in African countries in 1980 - 2007 period (Hailu, 2010). However, FDI also showed negative effects on the economy (Mencinger, 2008; Chaisrisawatsuk et al., 2007; Vudayagiri, 1999).

PHH was first introduced by Copeland and Taylor (1994) through the North American Free Trade Agreement (NAFTA). It was the 1st time that regulations on strict environmental protection to avoid pollution and trade agreements had been signed (Gill et al., 2018). Therefore, in the name of trade liberalization and economic development, multinational companies would shift production of dirty goods from developed countries to developing countries and underdeveloped economies or shift old and outdated technologies with high levels of pollution emission from countries with strict environmental regulations to countries with less strict regulations in the matter of environmental protection.

Contrary to the "pollution heaven/pollution potential" hypotheses, the "pollution halo" hypothesis stated that strict environmental regulations in countries would lead to the creation of cleaner and more efficient technologies. Clean and efficient technologies reduced marginal costs, thereby enhancing the productivity of the companies, helping them become more competitive (Porter and Linde, 1995) and contributed to reducing CO_2 emission (Frankel and Rose, 2002; Wheeler, 2001).

2.1.3. Theory of sustainable development

Sustainable development (SD) was seen as development that met current needs without affecting or compromising the fulfillment of these needs for future generations (WCED, 1987). In other words, sustainable development looked forward to economic development associated with habitat protection (Dobson, 1996) or economic development in parallel with conservation of natural ecosystem (IUCN, UNDP, WWF, 1991). Sustainable development was always attached to 3 pillars of economy, society and environment, taking into account the specific cultural factors of the locality (Spagenberg, 2002). Thus, the study showed the relationship between factors of economic integration such as trade liberalization, FDI and natural living environment.

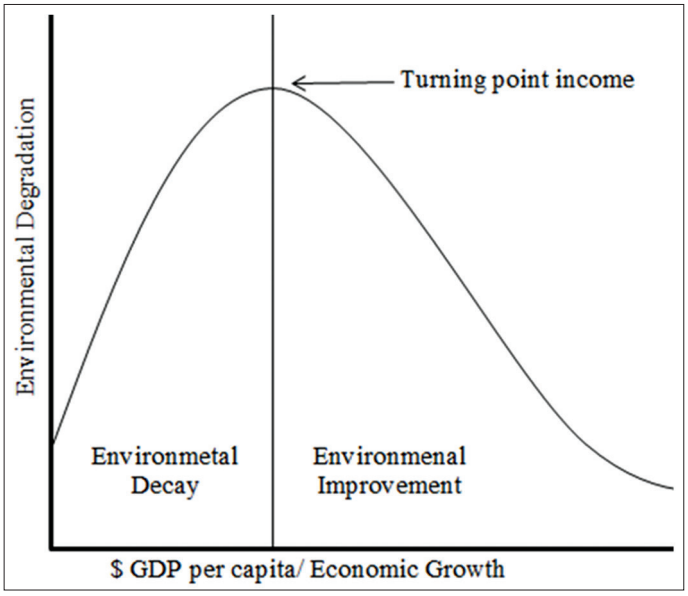
2.1.4. Correlation between economic growth and environmental pollution

Economic or income growth was one of the factors significantly impacting the level of environmental pollution. Grossman and Krueger (1991; 1995); World Bank (1992); Zhang and Zhou (2016) argued that the main reason for the difference in variables impacting environmental pollution was economic development level in each case study. Therefore, to understand this impact in a better manner, the study tested Environmental Kuznets curve (EKC) hypothesis test to show that environmental quality and income had an inverted U-shaped relationship in the long term (Shahbaz et al., 2017) in developing countries. According to Panayotou (1993), David (2004), EKC was a hypothesis of the relationship between indicators of environmental pollution emission and income per capita. This theory stated that economic activities were both the cause of the increase in environmental pollution in the short term (supporting "pollution heaven" hypothesis and contributes to reducing the EP in the long term (supporting of "pollution halo") (Mert and Caglar, 2020; Vo and Le, 2019; Nguyen et al., 2018; Shahbaz et al., 2017; Panayotou, 1993; Grossman and Krueger, 1991). In other words, the environmental pollution increased when income per capita increased to the occurrence of turning point at the entry point indicated an inverse relationship between average income and the decline in environmental quality (Kasman and Duman, 2015; Omri et al., 2015; Moenius and Berkowitz, 2004; Carter and Olinto, 2003) (Figure 1).

2.1.5. Impact of economic openness on economic growth

Trade liberalization had a positive impact on economic growth (Behbudi et al., 2010). In addition, FDI also played an important role in enhancing benefits related to new technologies, new

Figure 1: Kuznets curve for environmental pollutant emission



Source: Collected by the author from Panayotou (1993); Nguyen et al. (2018)

management techniques, developing skills, increasing capital to create job opportunities and improve labor conditions and development of domestic industries receiving FDI (Markusen and Venables, 1999; Haddad and Harrison, 1993; Solow, 1957).

Thus, economic openness (economic integration) including trade liberalization and FDI in emerging economies (Nguyen et al., 2018) were considered as two factors affecting economic growth (Markusen and Venables, 1999; Haddad and Harrison, 1993) through new technologies of machinery and equipment from developed countries (Lucas, 1998), development of human resources and employment, expanding international trade (Liu et al., 2004; Basu et al., 2003; Alguacil et al., 2002; Balasubramanyam, 1999; De Mello, 1999).

2.1.6. Impact of economic openness on the environment

From the above two theoretical bases, it could be seen that two factors including trade liberalization and FDI would have a significant impact on the natural environment quality of emerging economies in the process of promoting economic growth (Nguyen et al., 2018; Kahouli and Omri, 2017; Ertugrul et al., 2016; Zakarya et al., 2015; Grossman and Krueger, 1991). This impact may be a commutation because environmental pollution was in favor of the "pollution heaven" hypothesis (Vo and Le, 2019; Achryya, 2009; Aden et al., 1999; Dasgupta and Wheeler, 1997; Hettige et al., 1996; Arrow et al., 1995; Birdsall and Wheeler, 1993). Or it could be the driving force and opportunity for emerging economies to develop new techniques to reduce CO_2 emission through advanced technologies (Brucal and Roberts, 2017; Paramati et al., 2017; Asghari, 2013; Frankel and Rose, 2002; Wheeler, 2001; Zarsky, 1999; Birdsall and Wheeler, 1993).

Some effects of trade liberalization that could increase CO_2 emission included Naranpanawa (2011) in Sri Lanka (1960-2006); Fotros and Maaboudi (2011) in Iran (1971-2006); Shahzad et al. (2017) in Pakistan (1971-2010). In addition, institutional improvement factor could impact and reduce CO_2 emission in the long term in 14 Middle East and North African countries (MENA) (Al-Mulali and Ozturk, 2015). In contrast, weak institutions with less stringent constraints and regulations would create comparative advantage for emerging economies but also contribute to the formation of new "pollution heaven" (Le et al., 2016; Zakarya et al., 2015). However, trade liberalization also promoted the transfer of green technologies and focused on investment in renewable energy, contributing to environmental improvement in BRICS group of countries (Sebri and Ben-Salha, 2014; Hossain, 2011).

Then, FDI was both a factor contributing to environmental improvement through improving CO_2 emission (Frankel and Rose, 2002; Birdsall and Wheeler, 1993; Zarsky, 1999) such as in the Democratic Republic of Congo and South Africa (Kivyiro and Arminen, 2014); At the same time, FDI also contributed to increasing v emission into the environment in Brazil, China, India and the Russian Federation (1980-2007) (Pao and Tsai, 2011; Kenya and Zimbabwe (Kivyiro and Arminen, 2014); China (Jiang, 2015; Ren et al., 2014; He, 2006); in 39 underdeveloped countries (Jorgenson et al., 2007); 6 Sub-Saharan countries (1971 - 2009) (Kivyiro and Arminen, 2014); MENA countries (Abdouli and Hammami, 2017); South America (Sapkota and Bastola, 2017); Malaysia (1965 - 2010) (Hitam and Borhan, 2012); 5 ASEAN countries (Baek, 2016), In addition, the effect of FDI on CO_2 emission in an asymmetrical condition of information both in the short and long term with the covariant and contravariant results in Turkey (1974 - 2018) provided empirical evidence for "pollution heaven" and "pollution halo" hypotheses while affirming that short and long-term FDI policies should define target CO_2 emission (Mert and Caglar, 2020). In addition, FDI increased CO_2 emission in Kenya and Zimbabwe - supporting the "pollution heaven" hypothesis but showing opposite result in Congo (DRC) and South Africa - supporting "pollution halo" hypothesis (Kivyiro and Arminen, 2014). Finally, there was an evidence in 28 Chinese provinces (1997 - 2012) that FDI also had multidimensional (covariant and contravariant) effects on CO_2 emission, supporting the Kuznets environmental curve theory (Jiang, 2015).

2.1.7. Impact of Energy, Urban and FD on the environment

In addition, many studies also showed that the level of energy consumption (Energy) or urbanization (Urban) has a positive correlation with CO_2 emission (Bakhsh et al., 2017; Bollen et al., 2010); Jacobson, 2009; Ezzati et al., 2004; Cole et al., 2006; Tsuji et al., 2002.

In addition, the development of the financial market (FD) leading to a well-functioning financial system seen as an essential condition for a developing market economy (Levine, 2005; King and Levine, 1993) was also an indirect factor affecting the environment (Al-Mulali et al., 2013; 2015; Islam et al., 2013).

2.2. Institution Impacting CO_2 Emission in the Context of Economic Integration

According to North (1990), institution was defined as human-made constraints, was structured and interacted from many aspects, including politics, economy, culture and society. Therefore, the institution included informal constraints (rules of behavior

and conduct, traditional convention), formal binding rules (constitution, law...) and characteristics of executing them.

Approaching from an institutional perspective, school of new institutional economics focuses on considering the important role of the institutions for social objectives such as poverty reduction, growth or improvement of the EP (Menard and Shirley, 2005; North, 1990). Accordingly, the institutional economic theory studied people's motivations and orientations such as beliefs, norms and rules they created in the pursuit of economic growth objectives, capital or foreign investment (Menard and Shirley, 2005) to minimize the environmental impacts (Fernandez et al., 2018; Mesnard, 2011; Paavola, 2007). As such, the focus of this approach was to consider environmental issue associated with national governance institutional frameworks, towards the establishment of basic principles to improve environmental issue such as awareness of the majority and sustainable use of environmental resources (Paavola, 2007). Some institutional components that had special significance when it came to the establishment, allocation and monitoring of rights were: law, politics, administration and ideology (Mesnard, 2011).

In summary, the above arguments all implied the impact of the variables on EP problem. However, the institutional impact on environmental pollution level could be positive or negative on environmental pollution, in accordance with EKC theory (Nguyen et al., 2018; Perera and Lee, 2013)

Institutional reform could help countries grow economically and increase the emission to the environment (Herrera-Echeverri et al., 2014). On the other hand, economic growth contributed to increasing income, thereby changing people's perceptions of sustainable development or improving environmental pollution problem (Ren et al., 2014a; Dal Bo and Rossi, 2007; Babiker, 2005). In other words, institutional quality reform was always oriented towards innovation and development of environmentally friendly technologies (Mehic et al., 2014; Hoekman et al., 2005) or the competition among emerging countries also resulted in higher economic efficiency and subsequently less emission (Andersson, 2018). This was consistent with countries asymptotic to the entry point of Kuznets curve (Bomberg and Super, 2009; Gil de Zúñiga et al., 2009).

Thus, the impact of FDI, trade liberalization and national institution on CO_2 emission is a pressing issue in the context that the greenhouse effect was causing serious environmental consequences (Spangenberg, 2007).

In the subsequent section, the study presented research methodology and data to provide empirical results on the effect of economic openness from an institutional perspective on CO_2 emission in emerging economies.

3. RESEARCH METHOD

3.1. Research Data

According to studies by Tamazian and Rao (2010); Farzin and Bond (2006); Li and Reuveny (2006), factors affecting pollution level include: Income level (LnGDP), energy use (Energy), urbanization (Urban), trade liberalization (Trade), financial development (FD) and FDI. The study collected data related to these variables for 32 emerging economies (except for UAE, Kuwait, Oman and Qatar). Then, the study combined indicators of institutional quality in the model to assess the impact level on CO_2 emission (Table 1).

3.2. Research Models

This study inherited STIRPAT (Stochastic Impacts by Regression on Population, Affluence and Technology) model developed from IPAT model (Impact, Population, Affluence, Technology) (York et al., 2003; Harrison and Pearce, 2000; Stern et al., 1992), then varied to a logarithmic function (York et al., 2003; Dietz and Rosa, 1994, 1997). Therefore, the study aimed to test the empirical model with impacts from variables inherited from STIRPAT model (Nguyen et al., 2018; Huynh Van Eleven, 2019; Liu et al., 2017; Abid et al., 2016; McGee et al., 2015; Gani and Scrimgreour, 2014).

Besides, this study applied a small part of the R language (Rstudio) to perform graph's simulation of data statistics and the correlation matrix of the variables.

$$LnCO2_{it} = \beta_0 + \Upsilon * LnCO2_{it-1} + \alpha_j * X_{it} + \beta_1 * Trade_{it} + \beta_2 * FDI_{it} + \beta_3 * INS_{it} + \beta_4 * INS_{it} * Trade_{it} + \beta_5 * INS_{it} * FDI_{it} + \beta_6 * Trade_{it} * FDI_{it} + \beta_7 * INS_{it} * Trade_{it} * FDI_{it} + \varepsilon_{it}$$

In which, the variables in the analytical model are presented in Tables 2 and 3.

3.3. Research Methododlogy

The study used annual unbalanced table data for 32 emerging economies (EMEs) in 2002 - 2014 period with dependent variable

Table 1: List of CO_2 emission rating of 32 countries

America	Ranking	Europe	Ranking	Africa	Ranking	Asia	Ranking
Argentina	30	Bulgaria	60	Egypt	27	China	1
Brazil	12	Czech Republic	37	Mauritius	139	India	3
Chile	44	Greece	50	Nigeria	43	Israel	51
Colombia	47	Hungary	59	South Africa	15	Malaysia	23
Mexico	13	Poland	20	Asia	Ranking	Pakistan	31
Peru	55	Romania	46	Philippines	36	Thailand	22
Venezuela	32	Russia Federation	4	South Korea	9	Vietnam	29
Europe	Ranking	Slovenia	93	Bangladesh	48		
Ukraina	25	Turkey	16	Indonesia	10		

Sources: Collected by the author from Nguyen et al. (2019) calculated by EDGAR's Global Fossil CO_2

Table 2: Description of research variables in the research model

Variables	Calculation	Sources
Dependent variable		
Ln CO_2 (CO_2 emissions)	Logarithm nepe of CO_2 emissions (ton per capita)	Emissions Database for Global Atmospheric Research (EDGAR)
Control variables	$\alpha_j * X_{it}$	
LnGDP (Gross Domestic Productivity)	Logarithm nepe of GDP per capita (constant 2010 US$)	World Development Indicators (WDI)
Energy	Logarithm nepe of Energy use (kg of oil equivalent per capita)	WDI
Urban	Urbanization (% of total population)	WDI
FD	Domestic credit to private sector (% of GDP)	WDI
Financial Development		
Explanatory variables	$\beta_1 * Trade_{it} + \beta_2 * FDI_{it} + \beta_3 * INS_{it}$	
Trade (Trade openness)	(exports + imports turnover) (% of GDP)	Worldwide Governance Indicators (WGI)
FDI	Foreign Direct Investmetnt, net inflows (% of GDP)	WGI
Institutions variables	Standard error (SE) – The difference of each below variable value with its means for each country	WGI
Goeff	Government effectiveness indicator –SE	WGI
Requa	Regulatory quality indicator – SE	WGI
Law	Rule of Law indicator - SE	WGI
Corrup	Control of Corruption indicator – SE	WGI
Voice	Voice and Accountability indicator – SE	WGI
Politic	Political stability indicator - SE	WGI

Source: Collected by the author

Table 3: Descriptive statistics

Variable	Obs	Mean±Std. dev. (Standard deviation)	Min	Max
Ln CO_2	448	1.2680±0.9380	−1.417432	2.549498
LnGDP	448	8.7272±0.98768	6.313372	10.40642
Energy	448	1810.486±1285.289	0	5413.348
Urban	448	62.0486±19.1223	24.756	92.179
Trade	448	75.7434±40.4549	21.44693	210.3743
FD	448	56.8917±38.3914	0	160.1248
FDI	448	3.2472±4.3782	−15.96326	50.46318
Goeff	448	0.1902±0.0143	0.1551032	0.2292054
Requa	448	0.1780±0.0167	0.149819	0.2465838
Law	448	0.1456±0.0143	0.1192944	0.1848503
Concor	448	0.1434±0.01566	0.1198446	0.1971663
Voice	448	0.1327±0.0192	0.1037159	0.1896593
Politic	448	0.2454±0.0299	0.1922474	0.3273756

Source: Author's calculation

Table 4: Correlation matrix

	Ln CO_2	LnGDP	Energy	Urban	Trade	FD	FDI	Goeff	Requa	Law	Corrup	Voice	Politic
Ln CO_2	1.0000												
LnGDP	0.8114	1.0000											
Energy	0.8272	0.6883	1.0000										
Urban	0.6012	0.7790	0.4927	1.0000									
Trade	0.3534	0.2085	0.3252	−0.0847	1.0000								
FD	0.3883	0.2311	0.2892	0.0114	0.3899	1.0000							
FDI	0.1183	0.0693	0.0867	0.0936	0.2425	0.0289	1.0000						
Goeff	0.3049	0.4240	0.2685	0.2451	0.2388	0.2207	0.0260	1.0000					
Requa	0.1322	0.2817	0.1354	0.2132	0.0166	0.0987	−0.0606	0.3406	1.0000				
Law	−0.1327	−0.0965	−0.1065	−0.0698	−0.0929	−0.0829	−0.0867	−0.3844	0.4982	1.0000			
Corrup	−0.2356	−0.0888	−0.1907	−0.0206	−0.2588	−0.1603	−0.1125	−0.2699	0.4440	0.7531	1.0000		
Voice	0.1434	0.1415	0.1406	0.0800	0.0375	−0.1038	−0.0140	−0.3260	0.3396	0.8364	0.5768	1.0000	
Politic	−0.0926	−0.1617	0.0106	−0.1390	−0.0343	−0.2027	0.0044	−0.6077	0.0667	0.6634	0.6892	0.6831	1.0000

Source: Author's calculation from Stata 15

hysteresis (d1Ln CO_2). Accordingly, the basic defects of the common unbalanced table data model including autocorrelation, heteroscedasticity and multicollinearity were overcome by system GMM - SGMM estimation method). This method proposed by Arellano and Bond (1991), Arellano et al. (1995) and developed by Blundell and Bond (1998) minimized bias with fixed effects in short table data. In addition, this method could solve the endogeneity problem of dynamic models containing dependent

variable hysteresis that other regression models coundn't handle (Nguyen et al., 2018; McLachlan and Peel, 2004).

Besides, the study applied a small part of the R language to perform graph simulation of data statistics in the research model and graph the correlation matrix between the variables.

4. RESEARCH RESULT AND DISCUSSION

Correlation matrix results are presented in the Table 4 and Figure 2.

Firstly, economic growth or GDP per capita (LnGDP) was positively related and has a negative impact on CO_2 emission in line with Kuznets curve. This result showed that emerging countries had to exchange between the increase in incomes and the decrease in quality of living environment. However, LnGDP2 showed an inverse relationship with CO_2 emission or economic growth to a certain threshold changed people's consciousness and CO_2 emission decreased (Mert and Caglar, 2020; Azam and Khan 2014; Saboori et al., 2012; Lean and Smyth, 2010b).

Secondly, the variable using energy (Energy) had statistical significance in explaining the impact on CO_2 emission. The study showed covariant correlation between energy consumption and CO_2 emission. Indeed, Energy played an important role in the process of industrialization and development, which would increase CO_2 emission into the environment and was the main cause of greenhouse effect (Al-Mulali and Ozturk, 2015; Sebri and Ben-Salha, 2014; Bollen et al., 2010; Jacobson, 2009; Chan and Yao, 2008; Ang, 2008; Ezzati et al., 2004; Tsuji et al., 2002). However, the impact level of Energy in this study was nearly negligible.

Thirdly, the development of financial market was also the cause of higher CO_2 emission (Nguyen et al., 2018; Wu and Hsu, 2016).

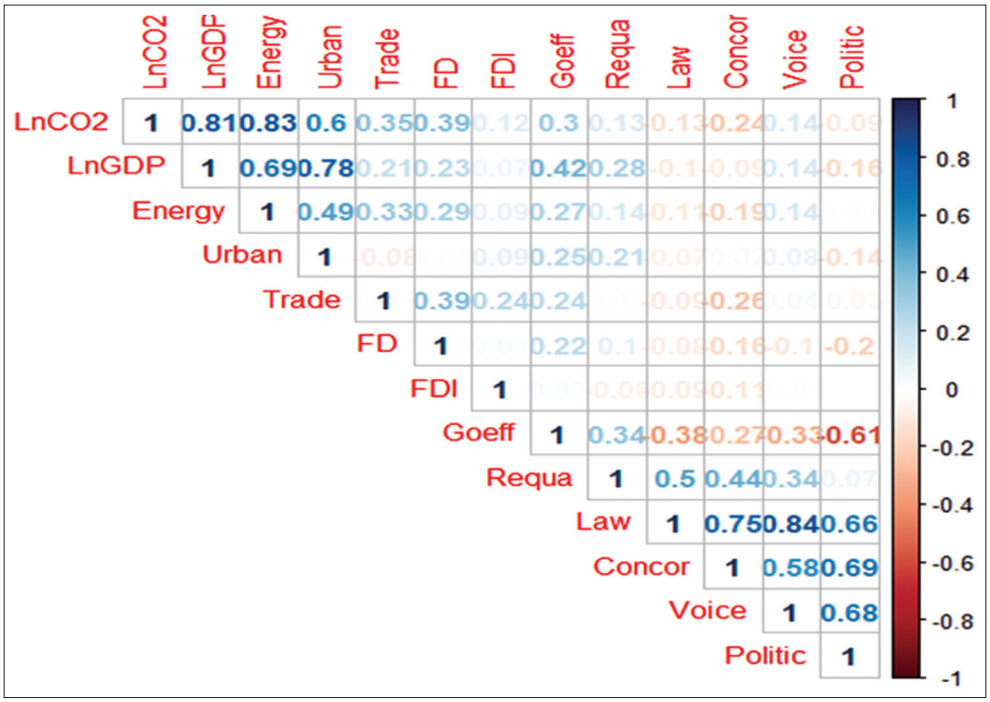
Fourthly, the study found no evidence of urbanization's impact on CO_2 emission into the environment.

Fifthly, the explanatory variables including Trade, FDI all had multidimensional correlation (in the same and opposite direction) to the level of CO_2 emission depending on the combination with institutional variables. The impact of Trade and FDI could increase CO_2 emission in emerging countries (Shahbaz et al., 2017; Zakarya et al., 2015; Fotros and Maaboudi, 2011) was consistent with "pollution heaven" hypothesis in emerging economies (Ren et al., 2014b). At the same time, the study result also showed that the opposite effect of Trade and FDI on CO_2 emission is consistent with "pollution halo" hypothesis (Table 5).

4.1. The Result Supported "Pollution Heaven" Hypothesis when the Model Included 3 Institutional Variables Related to Government Efficiency (Coeff), Quality of Law (Law) and Level of Corruption Control (Corrupt) Had an Impact in the Same Direction with CO_2 Emission

For commercial activities, import and export activities helped stimulate production and consumption. Both production and consumption activities contributed greatly to EP emission (Abdouli and Hammami, 2017; Solarin et al., 2017; Abid et al., 2016). Developed countries could export environmental pollution-causing industries, such as petrochemical and cement, textile and dyeing industries, to developing countries with lower environmental standards. Under such conditions, higher commercial openness could increase environmental problems.

Figure 2: Correlation matrix with Rstudio



Source: Author's coding from Rstudio

Table 5: Economic integration and CO_2 emission: Institutional impact of countries

CO_2	Goeff	Requa	Law	Corrup	Voice	Politic
d1Ln CO_2	−0.799 (0.999)	−0.135 (0.633)	−0.083 (0.352)	−0.198 (0.229)	0.151 (0.709)	−0.222 (0.637)
LnGDP	3.087*** (0.493)	2.774*** (0.746)	4.318*** (0.645)	4.235*** (0.818)	2.769*** (0.545)	2.967*** (0.555)
LnGDP2	−0.158*** (0.028)	−0.129*** (0.043)	−0.220*** (0.036)	−0.215*** (0.045)	−0.129*** (0.030)	−0.143*** (0.030)
Energy	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Urban	−0.001 (0.003)	−0.004 (0.004)	−0.003 (0.004)	−0.005 (0.004)	−0.003 (0.003)	−0.003 (0.004)
Trade	0.096*** (0.018)	−0.012 (0.027)	0.042** (0.020)	0.040** (0.018)	−0.033** (0.014)	−0.020* (0.010)
FD	0.000 (0.001)	0.002* (0.001)	0.002* (0.001)	0.002** (0.001)	0.002** (0.001)	0.003** (0.001)
FDI	1.718*** (0.407)	−0.166 (0.530)	0.659* (0.345)	0.611** (0.290)	−0.898** (0.347)	−0.689*** (0.194)
INS	59.204*** (11.719)	−4.749 (14.295)	29.756** (11.118)	24.122** (11.053)	−21.159** (9.955)	−10.259** (4.153)
INS*Trade	−0.496*** (0.095)	0.065 (0.154)	−0.293** (0.139)	−0.285** (0.133)	0.257** (0.105)	0.084* (0.043)
INS*FDI	−9.068*** (2.179)	0.928 (3.007)	−4.618* (2.514)	−4.426** (2.146)	6.729** (2.646)	2.851*** (0.814)
Trade*FDI	−0.012*** (0.003)	0.002 (0.006)	−0.006 (0.004)	−0.006* (0.003)	0.009** (0.003)	0.005** (0.002)
INS*Trade*FDI	0.062*** (0.016)	−0.013 (0.031)	0.045 (0.029)	0.045* (0.023)	−0.064** (0.024)	−0.020** (0.008)
Obs	416	416	416	416	416	416
Countries	32	32	32	32	32	32
AR(2) (P-value)	0.568	0.233	0.624	0.178	0.125	0.591
Kiểm định Hansen (P-value)	1.000	1.000	1.000	1.000	1.000	1.000

*P<0.1; **P<0.05; ***P<0.01. Source: Author's calculation from Stata 15

In addition, FDI factor was the driving force for economic growth (Adeleke, 2014; Dixit, 2012). On the other hand, FDI indirectly caused environmental problems (Zhang and Zhou, 2016; Baek and Koo, 2008; Chan and Yao, 2008). Through FDI, multinational companies in "dirty" industries would shift production activities to developing countries (Cole et al., 2006; Williamson et al., 2006). This implied that developing countries were becoming destinations for FDI inflows with outdated production technology and management and polluting production activities. This shift not only led to production restructuring but also changes in trade model among countries (Cole et al., 2017; Cole and Elliott, 2003). Accordingly, the government had a decisive role in attracting and managing FDI inflows effectively and minimizing negative impacts on the environment. From this argument, the study opened a direction to consider the role of the government in both institutional and policy aspects in the relationship between FDI and EP.

4.2. The Result Supported "Pollution Halo" Hypothesis When the Model Included Two Institutional Variables Related to Voice (Voice), Level of Political Stability (Politic)

Cole (2004) argued that trade openness could reduce pollution by countries with improved access to environmentally friendly technologies. However, these two variables (Trade and FDI) should be considered in relation to other variables in the research model to conclude the effect of FDI on CO_2 emission (Pao and Tsai, 2011).

4.3. Regarding the Combined Effects, the Research Result Showed that the Research Result Both Supported "Pollution Halo" Hypothesis and "Pollution Heaven" Hypothesis

In terms of "pollution halo," improved institutional quality contributed to impact on economic objectives (Solarin et al., 2017; Ibrahim and Law, 2015; Adeleke, 2014; Lau et al., 2014; Gani and Scrimgeour, 2014; Dixit, 2012)., especially in low-income economies (Perera and Lee, 2013) through economic growth (Dutta et al., 2013), improved redistribution of resource (Ebeke et al., 2015) or production (Moennius and Berkowitz, 2004; Carter and Olinto, 2003) and the environment in developing countries through regulations and legal quality to reduce CO_2 emission (Dal Bo and Rossi, 2007). In other words, the interaction between FDI and institution (INS * FDI) or the openness of trade and institution (INS * Trade) had a negative sign implying that the improvement in the quality of institution would reduce the negative effects of FDI to the environment (Bissoon, 2011). Indeed, when the quality of institution increased, government policies and regulations related to FDI inflows became stricter, targeting high-quality FDI inflows, which meant that there were modern production and management technologies, more efficient and appropriate post-production waste treatment technology. Therefore, the interaction between quality of institution and FDI had the effect of improving environmental quality, reducing CO_2 emission in developing countries (Neequaye and Oladi, 2015). Besides, better corruption control helped control environmental issues in emerging economies. Indeed, weak institution through failure to control the corruption well would create opportunities for companies, especially multinational companies to transfer outdated technologies that were harmful to the environment without sanctioned (Damania et al., 2003).

On the contrary, the research result also showed that the increase in FDI inflows made environmental problems increasingly more serious in emerging economies (Behera and Dash, 2017; Baek; 2016; Zhang and Zhou, 2016; Kivyiro and Arminen, 2014; Baek and Koo, 2008; Chan and Yao, 2008; Jorgenson et al., 2007; He, 2006). Thus, national institution had a decisive role in economic integration, including attraction and effective management of FDI inflows. From this argument, the study provided important empirical evidence to confirm the important role of institution and policy in the relationship between FDI and EP.

5. CONCLUSION

Greenhouse effect has become a problem that many countries had to worry about in the 21st century (Mert and Caglar, 2020; Spangenberg, 2007). In particular, emerging countries often

experienced high economic growth, accompanied by the increase in environmental problems. This study provided empirical evidence on the impact of institution on CO_2 emission through the increase in economic integration, which contributed to the shift of technological factors from developed economies to countries, group of developing countries, emerging economies. The effect of this asymmetric shift may be consistent with "Pollution heaven" hypothesis and "Pollution Halo" hypothesis.

The study result confirmed that FDI inflows and trade openness had impacts on CO_2 emission, consistent with "pollution heaven" hypothesis and "pollution halo" hypothesis. More importantly, the impact combination of variables also showed that better quality of institution would help develop the economy, thereby raising awareness of people in these countries on environmental protection, contributing to reducing CO_2 emission but could also be the cause of the increase in CO_2 emission, this conclusion is consistent with Kuznets curve theory mentioned in the study.

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