GSEAS 山口大学大学院東アジア研究科
The Graduate School of East Asian Studies, Yamaguchi University

DOCTORAL DISSERTATION

Sustainable development in the context of globalization: Opportunities and challenges underlined by FDI, trade and institutional qualities toward a greener economy

by

DANG Phuong Thao

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I dedicate this dissertation to my beloved family, who are my endless source of support and encouragement. I could not finish this work without the help of my parents and parents-in-law, as well as the unconditional trust and love from my husband. Thank my darling for always believing in me, even more than I do myself. Thank my beautiful children for being my greatest inspiration. Raising children as a "Ph.D. mom" is not easy, but it is because of them that I want to answer the questions for a better world.

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ABSTRACT

This doctoral dissertation consists of three empirical studies using applied econometric methods under the research topic “Sustainable development in the context of globalization: Opportunities and challenges underlined by FDI, trade and institutional qualities toward a greener economy”. In this dissertation, both globalization forces and internal sociopolitical aspects are analyzed to examine how these factors affect growth and environmental quality in various countries, with a closer focus on developing economies and then Vietnamese small and medium-sized enterprises (SMEs). While many papers analyze the impacts of the globalization process or domestic sociopolitical aspects on the environment, there are few works attempting to address sustainability in a holistic approach of both outside and inside contexts. The research aims to provide a comprehensive discussion on how a country should match its integration level and its governance quality to achieve sustainable development. This unique focus makes the study distinct from the literature. The first and last chapters are the general introduction and conclusions of the whole research subject and objectives. There are four objectives:

- Objective 1: Testing the controversial EKC hypothesis in various models and samples to confirm its robustness.
- Objective 2: Studying the environmental impacts of FDI and trade, the two important drivers of globalization, with full consideration of the country-of-origin factor of FDI.

- Objective 3: Gaining insights into how FDI and trade interact with institutional properties and how these processes affect the environment.
- Objective 4: Understanding small-and-medium firms' behaviours regarding their environmental compliance and internationalization orientation in a weak institutional context.

The three empirical studies are presented in three main chapters of this dissertation, from Chapter 2 to Chapter 4. They are separate analyses but jointly address the research topic. The research scopes become narrower after each stage.

Chapter 2 - An empirical investigation of the Environmental Kuznets Curve (EKC) from an international economics perspective: trade, FDI and the origin factor of FDI: The Environmental Kuznets Curve (EKC) is a hypothesis of an inverted U-shaped relationship between environmental damage and income of a country, which means pollution tends to get worse as economic growth takes place, then starts to improve at a turning point over the course of development. This study tests the EKC hypothesis and studying the environmental impacts of FDI (from developed and developing partners) and trade, the two important physical aspects of globalization. In the panel of 51 developed and developing countries and the subpanel of 23 developing economies for the period from 2001 to 2012, the two-way fixed effect econometric model verifies the EKC's existence. Furthermore, the country-of-origin factor of FDI, which is largely ignored in the literature, is proved to be important to understand the impact of international investment on the environment. FDI from developed countries shows a robust halo effect which reduces carbon dioxide emissions through technology transfer

and development. Whereas, developing-country FDI and trade openness are associated with more polluting economic activities. The findings are expected to deliver important policy implications to national governments, especially in developing countries, and critical input to the international discussions on the linkage between the environment and cross-border flows of capital and goods.

Chapter 3 - Interaction between FDI and domestic factors in terms of their environmental impacts in developing countries: Utilizing the Environmental Kuznets Curve (EKC) model, this chapter examines the environmental impacts of institutional variables in their relationships with foreign direct investment (FDI) in 23 developing countries. All six elements of government indicators are tested while controlling their interaction terms with the two types of FDI, which originate from developed and developing regions. There are two important findings. First, FDI is proven to be an important channel to deliver the environmental effects of institutional qualities. Second, the FDI origin factor is critical to the nature of this interactive connection. FDI from developed economies is less affected by sociopolitical factors of a host country, while FDI from developing regions reacts differently in different domestic contexts. The study highlights the importance of institutional reform in the pursuit of sustainable development in the developing world, especially when most emerging countries are prioritizing FDI-led strategy to fuel their rapid economic growth.

Chapter 4 - Export propensity, informal payment, politician ties and the Environment Standard Certificates (ESCs) of Vietnamese SMEs: Using firm-level data from a survey of more than 2600 Vietnamese SMEs in 2015, the last study finds empirical evidence of how export and corruption affect firms' attitude toward

environmental protection. Export companies are more likely to obtain ESCs and that benefits their profit as ESCs complement the firms' images in international markets. However, as SMEs are more likely to obtain ESCs if they pay informal payments and have connections with public servants, ESCs in Vietnam maybe not reflect the real commitment of environmental protection. The study emphasizes the need for better corruption control to make pollution control certification reflect the real environmental protection attitude of firms.

All in all, this dissertation has achieved its research objectives set out in the first chapter. In the globalization era, when market forces greatly connect economies and drive firms behaviours, the role of environmental leadership at both national and international levels has become an essential element of the sustainable development. From that, a discussion on how governments and businesses should embrace globalization through a sustainable path is elaborated.

CHAPTER 1: INTRODUCTION

As global warming is growing to the biggest challenge for our future, the Paris agreement on climate change set the target that all countries must collaborate to keep the rise in the average temperature well below 2 Celsius degree. Therefore, sustainable development has become one of the top international and national concerns. According to the report "Our Common Future" by the World Commission on Environment and Development (Brundtland 1987), sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The definition consists of two key concepts: the "needs" of the present and future generations, and the "limitations" imposed by the technology level and social constitution on the ecological capacity of our planet. However, in many ways, sustainability can conflict with economic targets, especially for the developing world. For a long time, the emerging countries excluded themselves from environmental protection debates because their levels of greenhouse gas emissions were still much lower than the developed world. However, since they have been becoming more and more important players in globalization, their rapidly expanding economies and relatively low technology levels have caused soaring pollution, heightening stress on the ecosystem. It is time that developing governments could no longer deny their role in reducing the global environmental footprint. So far, for most emerging regions, economic growth is still the first priority. Their policymakers have widely embraced export-led growth and FDI-led growth strategies to pursue a higher GDP per capita.

Nevertheless, when national income surges, citizens become demanding on all aspects of living standards, including environmental quality. Thus, not only advanced but also developing regimes are facing both international and internal pressures of the quest for sustainability.

There are many heated ongoing arguments on the link between economic growth and environmental degradation, as well as the dual impacts of globalization on pollution. Since the findings of Grossman and Krueger (1991), the Environmental Kuznets Curve (EKC) has received the attention of the research community. The EKC theory features an inverted U-curve between income and environmental deprivation, arguing that an economy is likely to create more pollution in its first stage of expansion, then move to a greener phase later on. Although the EKC itself is a controversial topic, its equation form controlling the GDP and GDP square is widely utilized by scholars to test the environmental influence of various socio-economic elements, including trade and foreign direct investment (FDI). The cross-border flows of commerce and investment are two of the most important physical flows of globalization. They are also crucial drivers of the technical effect leading the EKC. These two factors are the focus of most economic agendas, especially in developing countries, though researchers have continuously discussed the dual impacts of trade and FDI on the environment. On one hand, FDI and trade foster technology transfer and renovation. On the other hand, they are associated with the outsourcing of heavy polluting industries from rich to poor countries (Bo 2011). Just like the EKC, there is little consensus about the environmental effects of international commerce and investment in the literature. Besides, whether or not FDI flows from different sources (i.e. investors from developed and developing

country groups) have different impacts on the environment is an important but mostly unanswered question.

While trade and FDI impose external challenges and opportunities for developing countries to grow sustainably, their institutional qualities largely decide how they embrace globalization. The performance of governments can be measured by many aspects, such as the seriousness of corruption, the extent of democracy, bureaucratic efficiency, the rule enforcement, the quality of policymaking, and political stability. So far, the influence of domestic factors on pollution has not attracted adequate research interest of scholars. There is a modest number of quantitative studies on the environmental impacts of institutional variables in general and on the pollution abatement tendency of foreign investors in particular. Among domestic performance qualities, corruption control is the most popular factor that has its environmental aspect discussed, following by regulation stringency and rule enforcement. However, the nexus between governance performance and pollution is rarely investigated in their interactive relationship with FDI and trade.

This doctoral dissertation consists of three empirical studies using applied econometric methods under the research topic "Sustainable development in the context of globalization: Opportunities and challenges underlined by FDI, trade and institutional qualities toward a greener economy". In this text, both globalization forces and internal sociopolitical aspects are analyzed to examine how these factors affect growth and environmental quality in various countries, with a closer focus on developing economies and then Vietnamese small and medium-sized enterprises (SMEs). The research aims to provide a comprehensive discussion on how a country should match its integration level

and its governance quality to achieve sustainable development. This unique focus makes the study distinct from the literature. While many papers analyze the impacts of the globalization process or domestic sociopolitical aspects on the environment, there are few works attempting to address sustainability in a holistic approach of both outside and inside contexts. The study develops several econometric models to address the research topic. There are four objectives:

- Objective 1: Testing the controversial EKC hypothesis in various models and samples to confirm its robustness.
- Objective 2: Studying the environmental impacts of FDI and trade, the two important drivers of globalization, with fully consideration of the country-of-origin factor of FDI.
- Objective 3: Gaining insights into how FDI and trade interact with institutional properties and how these processes affect the environment.
- Objective 4: Understanding small-and-medium firms' behaviours regarding their environmental compliance and internationalization orientation in a weak institutional context.

The three empirical studies are presented in three main chapters of this dissertation, from Chapter 2 to Chapter 4. They are separate analyses but jointly address the research topic. The research scopes become narrower after each stage.

Chapter 2 is an empirical investigation of the Environmental Kuznets Curve (EKC) from an international economics perspective, controlling trade, FDI and the origin factor of FDI. For the period from 2001 to 2012, in a panel of 51 developed and developing

countries and subpanels of the two groups, the two-way fixed effect econometric model is employed to test the EKC hypothesis and investigate the environmental impacts of FDI (from developed and developing partners) and trade. Furthermore, the country-of-origin factor of FDI, which is largely ignored in the literature, is duly taken into account.

Chapter 3 focuses on the interaction between FDI and domestic factors in terms of their environmental impacts in developing countries. Utilizing the Environmental Kuznets Curve (EKC) model, the study examines the environmental impacts of institutional variables in their relationships with foreign direct investment (FDI) in 23 developing countries between 2001 and 2012. All six elements of government indicators are tested while controlling their interaction terms with the two types of FDI, which originate from developed and developing regions.

Chapter 4 examines export propensity, informal payment, politician ties and the Environment Standard Certificates (ESCs) of Vietnamese SMEs. Using firm-level data from a survey in 2015 of more than 2600 Vietnamese SMEs, this chapter looks for empirical evidence of how export and corruption affect firms' attitudes toward environmental protection. Export companies are likely to obtain environmental certificates to complement the firms' images in international markets. However, if informal payments and connections with public servants influenced the certification process, domestic standards in Vietnam maybe not reflect the true level of environmental compliance.

The work contributes to the literature of the EKC, SMEs and the environmental impacts of trade, FDI and sociopolitical facets. The findings are expected to deliver important policy implications to national governments, especially in developing

countries, and critical input to the international discussions on the linkage between the environment and cross-border flows of capital and goods. Thus, a comprehensive discussion on how a country should match its integration level and its governance quality to achieve sustainable development is elaborated.

CHAPTER 2: An empirical investigation of the Environmental Kuznets Curve (EKC) from an international economics perspective: trade, FDI and the origin factor of FDI

2.1. Overview

Despite various conflicts and some heated parts, since the last half of the twentieth century, the world has been experiencing the most peaceful and stable period throughout history, providing the vital condition for continuous economic growth in many countries (Harari and Perkins 2014). Growth has become a global norm and the main target of governments. However, according to the Intergovernmental Panel on Climate Change (IPCC), economic activities are the main cause of global warming, the biggest environmental issue of our age, which in turn brings irreversible destruction to our ecological system. Lying at the center of the growth-environment nexus, the Environmental Kuznets Curve hypothesis (EKC) has become a key aspect of the environmental economics literature. Originally, the term Kuznets curve, named after Simon Smith Kuznets (1901 – 1985), the 1971 Nobel-prize-winner economist refers to an inverted U-shaped relationship between income inequality and economic growth, which hypothesizes that income inequality first rises then falls along the development path (1955). In the field of environmental policy technical study, a very similar possible pattern between environmental degradation and income of a country has captured the attention of the research community since Grossman and Krueger's remarkable article in 1991. The term "Environmental Kuznets Curve" (EKC) has become popular to indicate the hypothesis of an inverted U curve between environmental damage and income of a

country, which means pollution tends to get worse as economic growth takes place, then starts to improve at a turning point over the course of development.

The emergence of the EKC theory has changed the domain of environmental talks because in the past environmentalists and associated scientists generally claimed income growth as a threat to the environment (Stern 2004). It makes the idea of sustainable development, which is promoted in the report "Our Common Future" by the World Commission on Environment and Development in 1987 (Brundtland), become more achievable. In other words, if proved, it will answer the question of whether economic growth and sustainability are compatible (Selepe 2008). However, the EKC is a topic of debate from the beginning. Scientists argue about its shape (U-shaped or N-shaped), the level of income at the turning point and even its validity (Moomaw and Unruh 1997; Tang and Tan 2015; Yandle et al. 2002). A possible reason of this disagreement lies in the complicated nature of the EKC, which is the joint outcome of the environmental demand, the three income effects (namely scale, structure, and technology effects), and the dual impacts of international flows of trade and investment (Bo 2011).

Despite its complexity and controversy, the theory underlined by the EKC has been widely employed in empirical research on different economic elements in their relationship with growth and pollution. In a literature review of 51 EKC studies in various countries by Al-Mulali et al. (2015), the hypothesis is tested by various sets of variables and methodologies, but the majority of them include carbon dioxide emission, GDP per capita and GDP per capita squared in their models. While the EKC is verified by 39 out of 51 papers, in many cases, the main research interest is the impact of other explanatory variables in the growth – environment nexus, which is examined via EKC

models. Although the validity of the EKC is debatable, its function forms are broadly accepted to represent the dynamics of economic development and environmental degradation, thus facilitating the research of other socio-economic factors in that matrix. Popular additional explanatory variables are trade openness, FDI, energy consumption, population, industrial output, financial capacity, and urbanization.

In this study, the EKC hypothesis will be investigated from an international economics perspective by a panel of 51 countries, including 28 developed and 23 developing nations. The application of panel data analysis has merit over a time series data or cross-sectional data set. It allows the unobserved characteristics of each country to be controlled. (Wooldridge 2008). With an additional time variable in the two-way fixed effects model, the unobservable effect of each year is also captured. (Greene 2011). Besides the basic variables of traditional EKC models (CO_2, GDP per capita and GDP per capita square), the presence of foreign direct investment (FDI) and trade openness is important to deliver policy implications. They represent the necessity of evaluating the EKC from an international economics angle. As globalization has become an inevitable tendency, every country must define its position and strategy to integrate into the global market. Trade and FDI are the most dynamic factors of globalization, reflecting the flows of capital and goods worldwide. Through the scope of trade and FDI, an economy directly exerts its influence on the wealth and life quality of other nations. Moreover, FDI and trade share similar characteristics in the relationship with growth and environment, having either positive or negative impacts. Scholars disagree about the nature of these relationships, debating about whether these two economic indicators benefit or undermine the environment (Haisheng et al. 2005). Nevertheless, they

commonly acknowledge that trade and FDI are two of the important mechanisms driving the EKC (Antweiler et al. 2001; Bo 2011).

Furthermore, whether the origin of FDI affects its influence on the environment is an interesting question. In the last decades, FDI from developing countries has been increasingly contributing to world investment. While rich economies dominated cross-border capital flow until the end of the twentieth century, emerging markets have been playing more and more important role since then. Increasing ten times in the last 15 years, developing-country FDI outflow now accounts for approximately one-third of global annual flow. Accordingly, their FDI overseas stock has risen steadily to more than 20% of global FDI stock. Although advanced economies still take the larger share, emerging countries have become significant investors outside their borders. Nevertheless, research on the differences between the two FDI sources is in its infancy. In order to understand the impacts of different investor groups on other countries' economic growth and environmental degradation through cross-border investment, this study will control both FDI from developed countries and FDI from developing countries in the empirical test. It will be the first time FDI flows from different sources have been treated separately in a pollution model. The country-of-origin factor has been largely ignored by previous researchers because most of the time all FDI flows are pooled altogether or distinguished by receiving economies (Blonigen and Wang 2004). This study argues that previous researchers have not given adequate attention to this aspect, and aims to fill the knowledge gap.

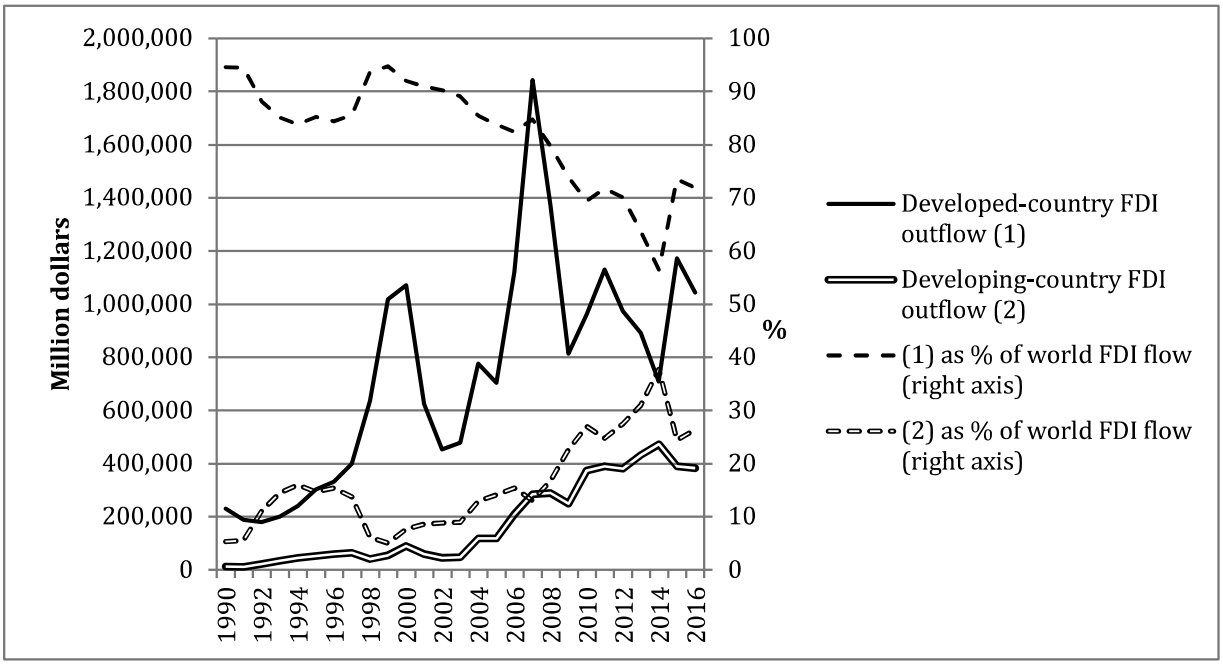


Figure 1. FDI outflows from developed and developing countries, 1990-2016. Source: UNCTAD.

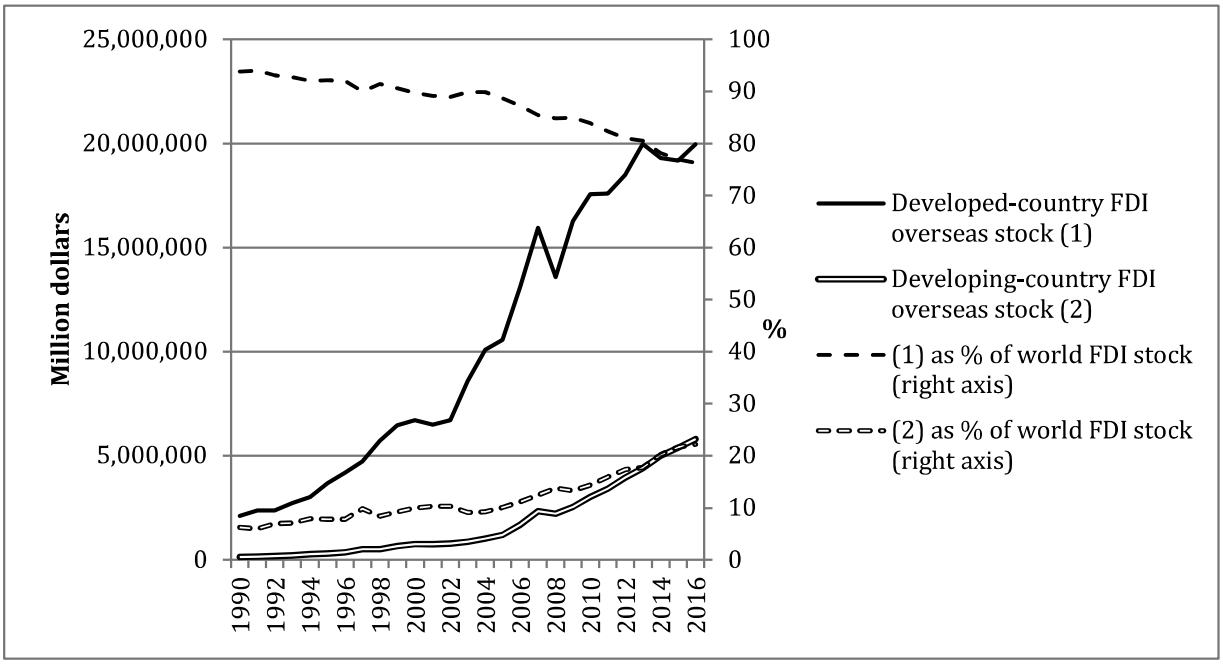


Figure 2. FDI overseas stocks of developed and developing countries, 1990 - 2016.

(Source: UNCTAD)

In short, the application of the EKC model in this chapter serves two main purposes: to test the EKC hypothesis itself and to explore the roles playing by trade and FDI in environmental situations of host countries, especially regarding the origin factor of FDI. The same model will be run for the whole panel and then validated for each of the developed and developing countries subpanels to compare and discover more insights. While the novel consideration of FDI sources gives the study its originality to contribute to the literature, its model is simple but effective enough to answer the research questions. The findings are expected to provide crucial policy implications to national governments and critical input to the international discussions on the linkage between the environment and cross-border economic activities. Policymakers may earn a great understanding of their country's position in the matrix of the globalization era, thus finding the way to achieve prosperity while minimizing their impact on the environmental quality of not only their own country but also other countries and the global common. As Moomaw and Unruh (1997) stress that the transition into greener economic structure should not be taken for granted as a definite outcome of growth, and there does not exist a fixed level of income at the top of the curve for all nations, identifying the strategy to lower the turning point and reach it in the best manner with the lowest total cost is the most challenging task for governments. The remaining parts of this article are organized as follows: Section 2 is the methodology and model justifications. Section 3 presents the empirical result and discusses its interpretations. Finally, Section 4 covers conclusions and policy recommendations.

2.2. Literature review

The relevance of controlling FDI and trade in the EKC pollution function is well defined by literature. While considered as drivers of growth (Campos and Kinoshita 2002; Frankel and Romer 1999), FDI and trade have dual impacts on the environment. On the one hand, they foster technology transfer and renovation. On the other hand, they are associated with the outsourcing of heavy polluting industries from rich to poor countries and the rapid increase of the scale effect (Bo 2011).

For FDI, its relationship with the environment consists of two schools of thought, namely the pollution haven effect and the FDI halo effect. The pollution haven hypothesis states that FDI is harmful to the environment because multinational companies (MNCs) tend to seek cost reduction by moving to countries with lower environmental standards. According to Cole and Elliott (2005), globalization has made the competitive position of a country become more sensitive to environmental regulations since trade barriers are falling down. Investigating the American FDI outflows, they state that "dirty" industries are likely to relocate to less developed countries with laxer pollution control. Kellenberg (2009) adds that the phenomenon also happens in relative "footloose" industries, such as electrical equipment and components, which are often associated with lower relocation costs and regarded as insignificant polluters. Furthermore, Poelhekke and Ploeg (2012) highlight that the enforcement of environmental regulation plays a more important role than the policy stringency itself. In alignment with this point, from the developing countries' perspective, Pao and Tsai (2011) suggest that pollution haven effects can happen in both active and passive processes. Not only are emerging economies relaxing environmental regulations to

attract greater FDI inflow to fuel their growth, but also their governments don't have enough capacity to hold the enforcement up to the level established in policies. His point is supported by quite a few studies in rapidly expanding markets showing that FDI is positively correlated to carbon dioxide emissions (Haisheng et al. 2005; Lau et al. 2014; Sapkota and Bastola 2017).

On the contrary, the halo effect advocates argue that FDI has a pro-environmental spill-over effect as it is a mean of know-how transfer (Doytch 2012). There is much evidence that FDI induces environment-friendly technology in emerging countries (Al-mulali and Foon Tang 2013; Pao and Tsai 2011). The effect even exerts itself on unaffiliated domestic firms thanks to the increasing mobility of the workforce (Vera-Cruz and Dutrénit 2005). Furthermore, Eskeland and Harrison (2003) suggest that foreign firms remarkably use cleaner energy with better efficiency comparing to their domestic peers. Doytch and Narayan (2016) prove the same point again in a panel of 74 countries from 1985 to 2012, showing that FDI encourages the use of renewable energy and discourages fossil fuel resources. Besides, the scale of the FDI halo effect seems to greatly depend on the types of FDI and the host countries' context. FDI in the service sector is environmentally friendly while FDI in heavy industries creates pollution. FDI inflows to developed countries are greener than the flows going to less developed economies (Doytch and Uctum 2011). Nevertheless, it is worth to note that the halo effect may still exist in low environment safeguard destinations. Some of giant MNCs have internal environmental standards higher than the requirement of the host country. In order to increase their own competitiveness, they want to gain public favors and participate in the rulemaking process to push domestic standards forward (Garcia-

Johnson 2000). To this point, it is not clear that which school, pollution or halo, has more credibility. Some scholars support both sides of the argument (Pao and Tsai 2011; Poelhekke and Ploeg 2012). To the best of the author's knowledge, the paper by Zeng and Eastin (2012) is the only research empirically considering the FDI origin factor in environmental impact. However, they merely control FDI from developing countries without taking into account the developed-country FDI. Their results show that MNCs from less developed regions tend to commit to voluntary pollution abatement practices ISO 14001 in their foreign operation. The prevailing theory and the FDI origin factor will be addressed later in this text.

For trade, the debate around the impact of trade on the environment follows a similar path with FDI. Up to now, neoclassical economists have been embracing the idea that free trade would make everyone better off. Even lower-income communities or groups who receive smaller pieces of the cake would be much poorer without export (Krugman et al. 2015). In that sense, trade will ultimately help to raise living standards including environmental quality over time. The elaborate model developed by Antweiler et al. (2001) argues that trade has scale, composition and technology effects on pollution just like income. Because the technology effect is greater than the scale effect, the negative impacts of trade will be outweighed; thus, freer trade is good for the environment. However, Daly (1996) points out that while highly closed protected economies suffer from outdated technologies and over-exploitation of natural resources, it does not mean that any freer degree of trade is better for all countries. He criticizes trade without barriers is pushing the human economy beyond the ecological limit of the earth. It is the fact that carbon emissions related to trade have been increasing

substantially. From 1990 to 2008, carbon dioxide emissions in exported goods production increased by 80% worldwide. The average annual rate is 4.3%, faster than population growth (1.4%) and total global CO_2 emissions (2%), but slower than the rise in the value of trade (Peters et al. 2011). Ecological economists and environmentalists have been demanding that the World Trade Organization (WTO) plays a critical role in resolving the trade distortion caused by environmental cost externalization. However, at the pleasure of globalists and growth thirsty governments, WTO has been avoided the difficult task. It seems that WTO will not actively step into the heart of the environmental discussion until major polluters make the first move and bring back the climate change legislation to trade forums. Nonetheless, it is worth to note that the reluctance of WTO is partly due to the lack of concrete empirical evidence and the absence of a rational action agenda presented by climate economists. More research needs conducting to examine the environmental impact of trade from different angles in order to get globalists and environmentalists on the same page. The connection of trade and FDI with pollution explains their relevance to the EKC model while their complexity and controversy make them challenging research subjects. They are popular key variables of EKC studies.

2.3. Methodology

This research employs the EKC model to achieve two purposes: testing the EKC hypothesis and studying the environmental impacts of FDI (from developed and developing partners) and trade, the two important physical aspects of globalization. Despite the sheer volume of the EKC literature, only a minority of studies involve panel

data or cover a group of countries. Table 1 summarizes several critical EKC studies employing data analysis techniques.

Table 1. The literature on the EKC with panel analysis

Article	Sample	Period	Key variables other than pollutants and GDP	Methodology	Results
Orubu and Omotor (2011)	47 African countries	1990-2012		OLS Fixed effect, Random effect	EKC: Yes
Zeng and Eastin (2012)	48 developed and developing countries	1990-2005	ISO14001, FDI, FDI from developing countries, exports	Fixed or random effect (Not specified)	EKC: Yes FDI from developing countries exhibits commitment to protect the environment
Sapkota and Bastola (2017)	14 Latin American countries	1980-2010	FDI	Fixed effect, Random effect	EKC: Yes FDI: pollution havens effect
Neequaye and Oladi (2015)	27 developing countries		FDI, corruption	Two-way fixed effect	EKC: Yes FDI: halo effect
Atici (2012)	ASEAN	1970-2006	FDI, export, export to Japan, US, and China	Fixed effect, Random effect	EKC: Yes (N-shaped) FDI: Halo impact Export to Japan and US: No impact Export to China: Increase pollution
Cho et al. (2014)	22 OECD countries	1971-2000	energy	FMOLS Unit root tests, Cointegration,	EKC: Yes only in 15 countries
Acaravci and Ozturk (2010)	19 European countries	1960-2005	energy	ADRL, Granger causality	EKC: Yes only in Denmark and Italy
Narayan and Narayan (2010)	43 developing countries	1980-2004		Income elastic comparison, Unit root tests, Cointegration	EKC: Yes only for 35% of the sample and for Asian and Middle East panel
Jaunky (2011)	36 rich countries	1980-2005		Income elastic comparison, Unit root tests, Cointegration	EKC: Yes only in Greece, Malta, Oman, Portugal, and the UK

(Note: GDP stands for GDP per capita)

Based on methodologies, those studies can be divided into three groups. The first group is papers using conventional panel data approach, the fixed effect and random effect models (Atici 2009; Neequaye and Oladi 2015; Orubu and Omotor 2011; Sapkota and Bastola 2017; Zeng and Eastin 2012). The second apply more sophisticated time series techniques expanding for panel data such as Autoregressive distributed lag model (ADRL) or Fully modified OLS (FLOLS) (Acaravci and Ozturk 2010; Cho et al. 2014). Last are studies that employ the alternative approach developed by Narayan and Narayan, comparing short-run and long-run income elasticity of pollutants (Jaunky 2011; Narayan and Narayan 2010). The second and third groups can verify the EKC hypothesis for each country in the sample but require a sufficient time series dimension. Whereas, conventional panel data analysis techniques of the first group answer the question of whether or not the EKC is generally manifested for the whole panel. It is a better option for studies with relatively short intervals.

The EKC theory implies that environmental degradation is a function of GDP and square of GDP. In literature, most researchers prefer the linear logarithm quadratic model to perform the relationship between an environmental indicator, economic growth, and other controlled variables. Thus, in this study, after duly considering other method options, the following two-way fixed effect model is proposed to test the EKC hypothesis:

$$\ln(CO_2)_{it} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 (\ln GDP_{it})^2 + \beta_3 \ln FDIdved_{it} + \beta_4 \ln FDIdvig_{it} + \beta_5 \ln TRADE_{it} + \alpha_i + \theta_t + \varepsilon_{itt}$$

$$FDIdved = \frac{FDI\ from\ developed\ countries}{Gross\ domestic\ product} \times 100\%$$

$$\text{FDIdvig}=\frac{FDI\ from\ developing\ countries}{Gross\ domestic\ product}\ \text{x}100\%$$

$$\text{TRADE}=\frac{Import+Export}{Gross\ domestic\ product}\ \text{x}100\%$$

The annual carbon dioxide emission (CO_2) is selected as the environmental pollution indicator. GDP stands for the gross domestic product per capita in real terms (in constant 2010 USD). FDIdved is the ratio of the FDI inflow stock from developed economies as a percentage of the gross domestic product in a given year for a country. Meanwhile, FDIdvig refers to the similar variable attributed to the developing investor group. TRADE measures the level of trade openness as a proportion of both import and export to the same denominator. For example, FDIdved of China in 2001 is its FDI-to-income ratio calculated from the sum of bilateral FDI stocks invested by all developed countries in that year. All variables are transformed into their natural logarithm form to encourage stability in the variance-covariance matrix (Chang et al. 2001). Last, α_i represents the individual effect of each nation, θ_t stands for the time effect of each year, and ε denotes the random disturbance. The conversions of trade and FDI into percentages of income are important to eliminate the effect of inflation and to make all economies with various scales comparable. FDI stock is used instead of FDI annual flow because it reflects the real influence of existing foreign companies better. After an investment is made, it circulates in the economy and continuously come back to its owner to generate profit for years to come. Besides, the accumulated stock data less suffers from market fluctuation, business circle and other year specific factors.

Annual data are obtained for the period between 2001 and 2012 from the World Development Indicators (WDI), UNCTAD, and the UN Comtrade Database. The panel data of the study covers 51 countries, including 28 developed and 23 developing nations. The full list of countries is attached below.

Table 2. List of countries

28 Developed countries	23 Developing countries
Australia	Argentina
Austria	Armenia
Canada	Bangladesh
Czechia	Bulgaria
Denmark	Cambodia
Estonia	China
Finland	Croatia
France	El Salvador
Germany	Hungary
Greece	Macedonia (no trade data in 2008)
Hong Kong	Republic of Moldova
Ireland	Nigeria (no trade data in 2004 and 2005)
Italy	Pakistan (no trade data in 2001 and 2002)
Israel	Papua New Guinea (no trade data from 2005 to 2010)
Japan	Paraguay
Latvia	Peru
Macao	Philippines
Netherlands	Poland
New Zealand	South Africa
Norway	Thailand
Portugal	Turkey
Republic of Korea	Uganda
Singapore	Ukraine
Slovenia	
Sweden	
Switzerland	
United Kingdom	
USA	

The classification of countries into developed and developing groups follows the grouping system of the IMF[1]. The same criteria are applied to defined the two FDI investor groups. The period is limited by the availability of bilateral FDI data published on the UNCTAD statistics website. Besides, the time series of 4 developing countries (Macedonia, Nigeria, Pakistan and Papua New Guinea) are discontinuous because of missing trade records in some years. Therefore, this is an unbalanced panel with a total of 601 observations. While the time dimension of the panel is not so long, its cross-sectional dimension is wider than most samples in previous research. It is considered sufficient to deliver statistically reliable results.

The econometric process employed to estimate the panel is the two-way fixed effect within model. Basically, it is the extension of the fixed effect model method to include a time-specific effect. This is the most suitable panel data techniques for this research because the relatively short time dimension of the data, limited by the accessibility of bilateral FDI records, does not allow complicated time series based techniques. Besides, the income elastic comparison approach suggested by Narayan and Narayan (2010) is interesting but does not allow the inclusion of additional variables which is important to deliver policy implications. The random effect model option is also dropped because that technique is not available for an unbalanced panel with two-way fixed effects in the R environment for statistical computing. The same model will be run for the whole panel of 51 countries, then estimated separately for the two subpanels of developed and

[1] There are many country classification systems from different international organizations, that causes controversy. The author has considered between the two most popular grouping catalogs by the IMF and UNCTAD. However, the IMF designation is selected because it has clearer criteria and closer to common sense about who are developed and who are developing countries. The findings of this study are robust with both ways of classifications. For detailed results of the model in the UNCTAD grouping setting, please contact the author.

developing economies. If the U-shaped EKC is likely to take place, the coefficient of GDP will be positive while the coefficient of GDP squared is negative. It implies that the CO_2 growth pace will get slower when the GDP increases, and then turn into a downward trend after reaching the turning point. The signs of trade and two FDI variables decide their impacts on the environment. The negative sign is a halo effect, while the positive sign means increasing pollution.

2.4. Results

2.4.1. Estimations

The estimation result is displayed below:

Table 3. Estimation by two-way fixed effect within model

Unbalanced Panel: n=51, T=6-12, N=601

Residuals:

Min.	**1st Quarter**	**Median**	**3rd Quarter**	**Max.**
-0.5980	0.0475	-0.0034	0.0479	0.4095

Coefficients:

	Estimate	**Standard Error**	**t-value**	**Pr(>|t|)**
LnGDP	2.7092	0.2201	12.3093	< 2.2e-16 ***
$(LnGDP)^2$	-0.1108	0.0128	-8.6508	< 2.2e-16 ***
LnFDIdved	-0.1016	0.0209	-4.8696	1.475e-06 ***
LnFDIdvig	0.0257	0.0088	2.9391	0.0034 **
LnTRADE	0.0906	0.0370	2.4510	0.0146 *

Significance codes: p. < 0.001 '***' p. < 0.01 '**' p. < 0.05 '*' p. < 0.1 '.'

Total Sum of Squares: 10.208 Residual Sum of Squares: 5.6656

R-Squared: 0. 4450 Adjusted R-Squared: 0. 3764

F-statistic: 85.6349 on 5 and 534 DF p-value: < 2.22e-16

Overall intercept: 4.3923 (se: 0.9944)

The coefficients of GDP and GDP squared receive positive and negative signs respectively, featuring an inverted U-shaped curve between income and pollutant level. Both estimations the 0.1% significance levels, a confirmation of the EKC hypothesis. Interestingly, FDI from developed countries and FDI from developing countries receive adverse signs. The estimation of FDIdved is -0.1016 (0.1% significance), while one of FDIdvig is 0.0257 (1% significance). Although the estimation for FDI for less developed economies is somewhat less remarkable in both value and consistency, the concrete result from the wealthier counterparts clearly states that different groups of investors exert opposite impacts on the environment. FDI from rich countries shows a halo effect, benefiting the environment of host countries. Whereas, FDI from the lower-income group is associated with more pollution. It is worth to note that, given the same amount of investment, the green impact of developed investors is about four times outweighed the negative impact of developing ones. Taking into account that the developed countries still dominate the bigger share of global investment, the inferior impact of developing countries seems not to be striking. By a 5% confidence level, trade openness stands on the opposite side of sustainability. The rapid increase in international trade invokes environmental degradation. The goodness-of-fit, measured the adjusted R-squared, implies that 37.64% of the total variation in CO_2 explained by the regression model. This is a noteworthy level for panel data with a wide cross-sectional dimension. F-statistic also has a near 0 p-value. Therefore, the null hypothesis that all the coefficients are equal to 0 is rejected. The extracted overall intercept is 4.3923 with a standard error (se) of 0.9944. The model now can be rewritten as:

$$Ln(CO_2)_{it} = 4.3923 + 2.7092\ LnGDP_{it} - 0.1108\ (LnGDP_{it})^2 - 0.1016 LnFDIdved_{it}$$

$$+ 0.0257 LnFDIdvig_{it} + 0.0906 LnTRADE_{it} + \alpha_i + \theta_t + \varepsilon_{itt} \quad (1)$$

However, calculated from equation (1), the level of GDP at the turning point where emission starts to decrease as income increase is very high, at 203,950 constant 2010 US Dollar. This figure is questionable because it is much higher than the ones estimated by previous studies, which range from 15,500 to 68,900 US Dollars in 2010 price (Moomaw and Unruh, 1997; Yandle, Vijayaraghavan, and Bhattarai, 2002). It is possible that the EKC is strongly valid in a part of the panel but insignificant in the other part, misleading the estimation of the turning point for the whole panel. Therefore, the model and the turning point are then estimated for two subpanels, developed and developing country groups. Table 4 compares the main panel and two subpanels:

Table 4. The validity of the model in developed and developing subpanels

	51 countries	**Developed panel**	**Developing panel**
LnGDP	2.7092 ***	0.1635	3.4297 ***
$(LnGDP)^2$	-0.1108 ***	0.0178	-0.1710 ***
LnFDIdved	-0.1016 ***	0.0008	-0.1530 ***
LnFDIdvig	0.0257 **	0.0172 .	0.0282 .
LnTRADE	0.0906 *	-0.0407	0.2445 ***
R-Squared	0. 4450	0.2155	0.4428
Adjusted R-Squared	0.3764	0.1000	0.3491
Turning point GDP (2010 US Dollar)	203,950	No turning point	22,660

Significance codes: p. < 0.001 '***' p. < 0.01 '**' p. < 0.05 '*' p. < 0.1 '.'

Both subpanels are suffered from the shrunk sample sizes, which undermine the adjusted R-squared and some confidence levels. However, there are remarkable differences between the developed and developing groups. Neither a U-shaped curve relationship nor a turning point is featured by the developed-country panel. There is no clear pattern between GDP and CO_2 at any confidence level, either. In contrast, the developing panel demonstrates similar results to that of the whole sample. This result is surprising to many because the EKC is regarded as more likely to happen in rich regions. Comparing the two subsamples, a possible explanation is that developed countries have moved to a higher position on the development course where carbon emissions have been stable, and the growth rates have been slowed down, which makes the fixed effect model difficult to capture the relationship at this sample size. The model bases its estimation on variations within each country from one year to the next. Because these variations are small for developed countries, it is difficult to observe the pattern of this subgroup. Besides, there is no explicit implication of trade and developed-country FDI for the environment of developed host economies. Only some adverse impacts of FDI from developing investors still exist in this subpanel (10% significance). However, it is hard to reach any solid conclusion because the goodness-of-fit of the model is humble with the modest value of the adjusted R-squared (0.1).

In comparison, the EKC hypothesis is confirmed in the developing panel. All variables keep the same signs as the aforementioned results. All of their coefficients are confident though significance levels of TRADE and FDIdvig have changed. Nevertheless, the absolute values of the parameters of all three additional variables are higher than those of the whole sample. It seems that the policy implications of the model

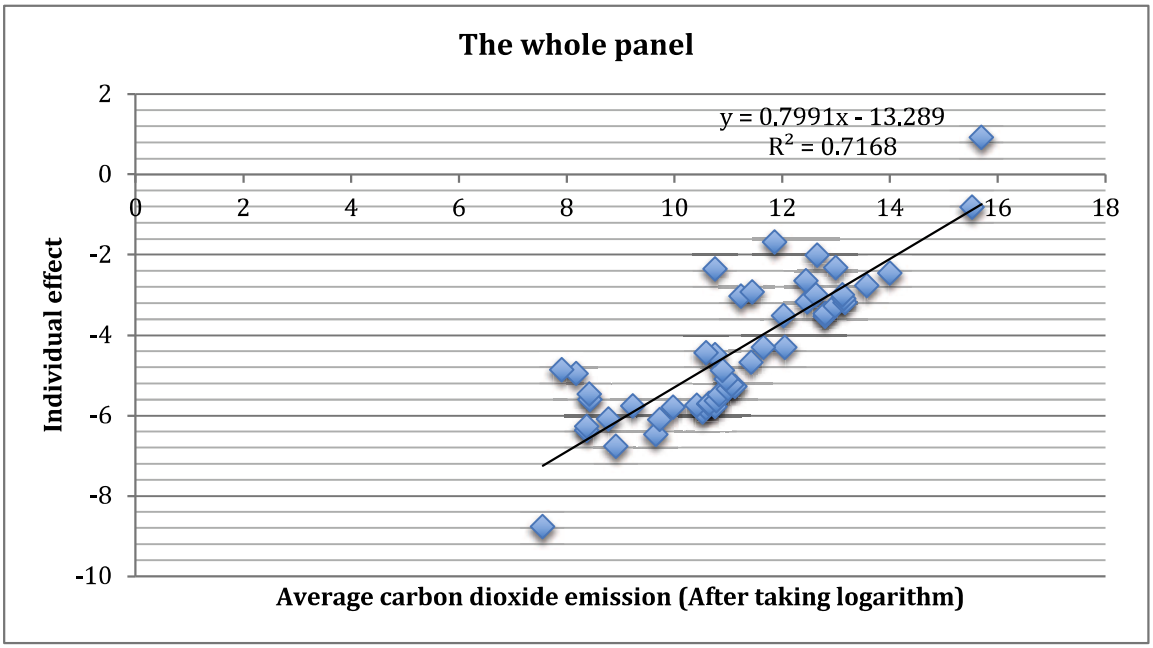
are more applicable to developing countries. The environment in less developed regions is more sensitive to the impacts of FDI and trade. The technology gap between developed and developing countries make the later witness greater improvement when knowhow transfer is facilitated by FDI from advanced investors, but their institutional weaknesses constrain them to prevent adverse influences of globalization in the environment of their countries. The turning point for the developing subgroup is 22,660 US Dollars, which is ten times lower than the estimation of the whole panel and stays within the normal range of previous studies. It could be the complication of the developed-country pattern that has confused the turning point calculation for the all-country panel. However, even this more reasonable turning point is still high for many developing countries of lower income, which is difficult to be realized in the near future. Moreover, it is necessary to note that this is only a prediction of the average GDP per capita at the turning point as there is no fixed level for all countries (Moomaw and Unruh 1997). The lower income a developing country is, the greater political effort required to achieve the transformation point sooner.

The results, especially in the developing-country subgroup, well verify the case of China, reported by Deng and Song (2008). China, the biggest receiver of FDI from developed investors and the global giant exporter of commercial goods, has experienced the green impact of foreign investment but paid a heavy environmental cost for export escalation. Meanwhile, it contradicts Zeng and Eastin (2012) who state that MNCs from developing regions put extraordinary effort into voluntary pollution abatement practices (ISO14001). This research argues that ISO14001 is not a good proxy for the pollution reduction capacity of all developing investors. Because it is not conducted by every

MNC, it does not represent the property of the whole population. Furthermore, the findings of FDI stock variables in this research are more concrete than that of studies controlling FDI flow regressors (Atici 2012; Neequaye and Oladi 2015) since the inflow variables are more prone to market fluctuation, business circle and other year specific factors.

2.4.2. Individual effects

The individual effect extracted for each country is correlated with the average carbon dioxide emission of that nation (after taking natural logarithm). The regression between them is illustrated in the following scatter diagram. The bigger the amount of emission a country releases, the closer to zero its individual effect. With the goodness-of-fit denoted as R^2 at 0.71677, approximately 72% of this relationship can be explained by the OLS. Meanwhile, the time effect ranges from -4.3432 to -4.4411, which is not greatly varied over the years. It implies that after adjusted by individual effect, big emitters have their individual equation nearer to the core part of Model 1, which is decided by independent variables. In other words, the major polluters influence the panel estimator to a greater extent. Apparently, the USA (-0.8096) and China (0.9220), the two global biggest emitters, most influence the estimation with the smallest absolute values of individual effect.



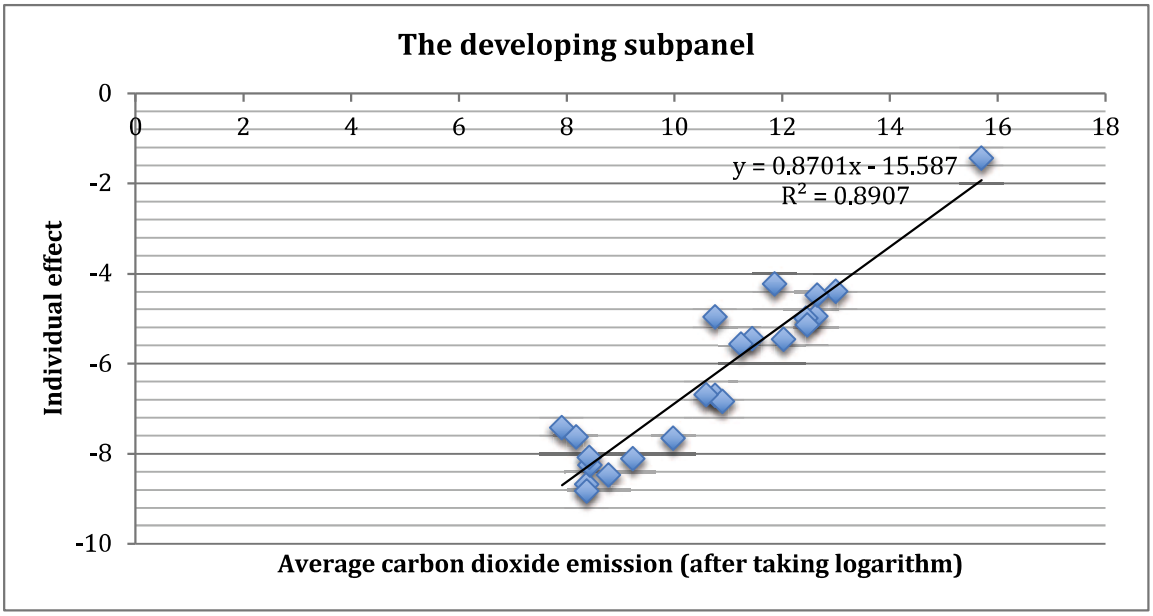


Figure 3. Country's individual effect and its average CO_2 emission.

Table 5. Country positions in comparison with the regression line in Figure 3

The whole panel			
Under the regression line		**Above the regression line**	
Australia	Israel	Argentina	Poland
Austria	Japan	Armenia	South Africa
Croatia	Latvia	Bangladesh	Thailand
Canada	Macao	Bulgaria	Turkey
Czechia	Netherlands	Cambodia	Uganda
Denmark	New Zealand	China	Ukraine
Estonia	Norway	El Salvador	**USA**
Finland	Portugal	Macedonia	
France	Republic of Korea	Republic of Moldova	
Germany	Singapore	Nigeria	
Greece	Slovenia	Pakistan	
Hong Kong	Sweden	Papua New Guinea	
Hungary	Switzerland	Paraguay	
Ireland	United Kingdom	Peru	
Italy		Philippines	

The developing subpanel			
Under the regression line		**Above the regression line**	
Argentina	Republic of Moldova	Bangladesh	Uganda
Armenia	Paraguay	Cambodia	Ukraine
Bulgaria	Peru	China	
Croatia	Poland	Nigeria	
El Salvador	South Africa	Pakistan	
Hungary	Thailand	Papua New Guinea	
Macedonia	Turkey	Philippines	

The individual effect also contains information about a country's economic structure. It explains the variation of each country from the regression line. If a country stays below the line, it seems to have a greener economic structure than a country with the same level of emission but above the line. China, the only country with positive individual effect (0.9220), has a similar emission scale to the USA. However, as China locates at a higher position in the graph, its economy more relies on heavily polluting

industries. The two countries are dominating players in the model, but they belong to different development levels. While the rapid expansion of Chinese economies heavily relied on fossil fuel energy, thus boosting carbon dioxide emission, the pollutant level of the USA is stable due to its slower growth rate and more energy-effective structure. Besides, the USA may have some merit over China because of its institutional and regulatory foundation. However, the USA itself has more heavy industries than other developed countries. In 29 countries under the regression line, 27 is developed countries (except Croatia and Hungary), whereas the USA is the only developed country marginally above the line. Macao (-8.7555) has the smallest value of individual effect because of not only its small scale but also its mostly-service-sector economy.

The same relationship can be illustrated for the country effects of the developing subpanel. Among this group, countries locating under the regression line have relatively greener economic structures. Whereas, for the rest of the group (China, Bangladesh, Pakistan, Cambodia, Philippines, Nigeria, Papua New Guinea, Uganda, and Ukraine), it may take greater effort to transform their economies toward environmentally friendly structures.

2.4.3. Robustness checks

Robustness check is the process examining how critical regression coefficients change when the model is altered, typically by adding or removing variables (Lu and White, 2014). Robustness checks are conducted for the whole panels and two subpanels. In Model 2 and Model 3, TRADE and FDIdvig are dropped respectively. Then, TRADE is divided into TRADEdved (trade with developed countries) and TRADEdvig (trade with developing countries) in Model 4.

Table 6. Robustness checks

51 countries				
	Main model	**Model 2**	**Model 3**	**Model 4**
51 countries				
LnGDP	2.7092 ***	2.8427 ***	2.6017 ***	2.772 ***
$(LnGDP)^2$	-0.1108 ***	-0.1221 ***	-0.1055 ***	-0.1146 ***
LnFDIdved	-0.1016 ***	-0.1012 ***	-0.0891 ***	-0.0977 ***
LnFDIdvig	0.0257 **	0.0245 **		0.0255 **
LnTRADE	0.0906 *		0.0917 *	
LnTRADEdved				0.0326
LnTRADEdvig				0.0273
28 developed countries				
LnGDP	0.1635	-0.1256	-0.0004	0.1887
$(LnGDP)^2$	0.0178	0.0333	0.0253	0.0148
LnFDIdved	0.0008	-0.0067	0.0074	0.0035
LnFDIdvig	0.0172 .	0.0182 .		0.0172
LnTRADE	-0.0407		-0.0523	
LnTRADEdved				-0.0016
LnTRADEdvig				-0.0608
23 developing countries				
LnGDP	3.4297 ***	3.4349 ***	3.3362 ***	3.5345 ***
$(LnGDP)^2$	-0.1710 ***	-0.1798 ***	-0.1656 ***	-0.1796 ***
LnFDIdved	-0.1530 ***	-0.1669 ***	-0.1339 ***	-0.1509 ***
LnFDIdvig	0.0282 .	0.0413 *		0.0227
LnTRADE	0.2445 ***		0.2678 ***	
LnTRADEdved				0.0633
LnTRADEdvig				0.1519 ***

Significance codes: p. < 0.001 '***' p. < 0.01 '**' p. < 0.05 '*' p. < 0.1 '.'

For the whole panel and developing subpanel, all variables maintain their sign across model variations. Significance levels of GDP, GDP square, TRADE and FDIdved are also unchanged. The estimations of FDI from developing regions are solid in the whole panel, but its significance level is altered among models in the developing subgroup panel. Meanwhile, there is still little meaningful result gained from the developed country subgroup. The robustness checks confirm that the aforementioned findings are robust against the alteration of model specifications, especially for the EKC, developed countries' FDI and trade openness in the main panel and developing subpanel.

2.5. Conclusions

By and large, the study confirms the validity of the EKC in a panel of 51 countries and its subpanel of 23 developing countries, taking into account the influence of FDI and the level of trade openness. The robustness of the model again specification alterations are also confirmed. Although this research is limited in explaining the pattern of the developed-country subgroup, which requires further study, the concrete findings in the developing subgroup show that the environment in countries of lower income is more sensitive to the globalization progression. Thus, the implications of this study are of great importance to their governments. The opposite effects of the two FDI flows explain why until now researchers have been confusing about the effect of cross-border investments. If incorporated into a single variable, they will neutralize the impact of each other, and the significance level will be undermined. On the one hand, the greater magnitude of the regressors found in the developing subgroup supports Doytch and Uctum's argument that domestic factors of a host country influence the attitude of investors toward environment protection (2011). On the other hand, the study adds that the development stage of an investor country also has a critical influence on the environmental orientation of its international investments. This is the most important contribution of the first research of the dissertation to the literature. The findings on developing-country FDI and trade, though not as significant and robust as one on developed-country FDI, are interesting because they contradict Zeng and Eastin (2012) and the well-known paper by Antweiler et al. (2001). Although Zeng and Eastin argue that investors from developing economies tend to voluntarily commit to higher pollution abatement requirements in host countries, it seems that MNCs from those regions are

still greatly hindered by their financial and regulatory competence. Besides, there is some doubt about the conclusion of Antweiler et al. that the technical effect of trade outweighs scale effect to benefit the environment.

These results deliver important policy implications to governments, especially in developing countries. First, all countries should enhance the screening of FDI to limit the harmful impacts of outdated techniques and promote know-how transfer. Policymakers, especially in developing countries, should bring up strategies to attract FDI from technical-intensive investors. However, while the FDI from developed countries shows a strong halo effect, that should not be interpreted that FDI from developing countries is totally undesirable. From an emerging economy's point of view, a better understanding is that their MNCs should respect the global standard of pollution abatement and commit to the best environmental practices to make their investments become more attractive outside the border. Given the integration tendency among developing countries to enhance their political and economic positions, it is critical that the process should pay due attention to limit environmental adverse impact arising from trade and investment within the same group. Second, developing governments should carefully reexamine their FDI-led and export-led growth strategies. While the efficiency of these strategies is questioned by recent research (Herzer et al. 2008; Pao and Tsai 2011), unsophisticated and indifferent pro-FDI and pro-trade policies can trigger long-term environmental costs. Third, international effort needs bringing up to address the trade distortion by environmental cost externalization, which is undermining the positive side of trade in contribution to sustainability. In other words, fair trade should be favored instead of free trade. Future multinational trade and investment agreements should

include a carefully tailored environmental framework to facilitate the adoption of higher pollution abatement requirements and to limit the negative side of trade, especially in developing countries. Last but not least, from the individual effect analysis, every country can understand their position in the global environment-growth nexus and foresee the degree of challenge they will face to pursue sustainability. By and large, this chapter agrees with Moomaw and Unruh (1997) that the turning point of the EKC is a political effort more than a conspicuous outcome of development.

The research paves the way for further investigations. First, it suggests a new hypothesis that polluting industrial migrations might currently happen among developing countries at different levels of development, rather than between rich and poor nations as proposed by the original pollution haven hypothesis. Second, the inclusion of other factors such as corruption or environmental regulation stringency may provide more insights and implications. Third, the country-of-origin factor of FDI can be tested against the host-country factor to see how domestic setting affects FDI from different regions. Last, other models can be brought up to test the developed-country subpanel, which is not explained thoroughly by this research. All mentioned above is a source of inspiration for future studies.

CHAPTER 3: Interaction between FDI and domestic factors in terms of their environmental impacts in developing countries

3.1. Overview

Many developing countries are relying on the FDI-led strategy to fuel their rapidly growing economies (Chandran and Tang 2013; Lau et al. 2014; Linh and Lin 2014). In the last several decades, emerging economies have been continuously encouraging FDI as a mean of development (Blanco et al. 2011). However, FDI has dual impacts on the environment of a host country. On one hand, it is an important channel for know-how transfer and technology spillover (halo effect). On the other hand, it worsens environmental quality with the relocation of heavy polluting industries to poorer countries (pollution haven effect) and the pressure of the increasing economic scale (Bo 2011). While this is a topic of debate for long (Doytch 2012), the previous chapter support both sides of the argument, showing that FDI from developed countries has a strong halo effect, while FDI from developing countries creates more pollution. In this study, the role of FDI sources is examined in another approach, with its interaction with sociopolitical facets of a host country. While Doytch and Uctum point out that the attitude of investors toward environment protection depends on domestic factors of a host country (2016), it is arguable that the development status of an investor country also has a significant influence on the pollution abatement level of its FDI outflows. The second study of this dissertation attempts to answer the question that whether foreign

investors from different country groups react differently to domestic factors of a host country in terms of pollution abatement.

The study employs the Environmental Kuznets Curve (EKC) model and the interaction terms to address the hypothesis. The EKC features an inverted U-shaped graph between pollution and economic growth of a country, implying that environmental problems tend to get worse in the early phase of economic expansion, before becoming stable and starting to go down as income continues to rise. In nearly three decades since Grossman and Krueger's remarkable paper (1991), the EKC is always a fascinating but debatable topic, which lies on the triangle of growth, environment, and sustainability. In spite of its complexity and controversy, the equation form underlined by the EKC theory has become popular in empirical literature to examine the role of various socio-economic factors in their connection with growth and pollution. In this study, the EKC model will be employed to examine the environmental impacts of corruption and other institutional indicators in the relationship with FDI in developing countries. The model investigates the relationship among environment degradation, FDI, and domestic factors (corruption and other government indicators). The impact of FDI's origin factor is controlled to find out whether investors from different country groups react differently to corruption and other institutional variables in terms of environmental issues.

This research has its originality for two reasons. First, the novelty of the study, inheriting from the previous chapter, is its treatment of FDI, paying duly attention to the origin factor of FDI. The role of FDI from developing countries has become more and more important in world investment. In the 1990s, investment from less developed regions was only a fraction of the global capital flow. However, the last 20 years have

witnessed a dramatic change with 10 times increase in developing-country FDI outflow, which has stayed over 400 billion USD annually since 2010. The rapid growth of emerging markets has spurred their economic power outside their borders. Although advanced economies still occupy the larger share, it is undeniable that emerging countries have become significant investors with more than 20% of global FDI stock (UNCTAD). Nevertheless, the differences between FDI from developed and developing countries have received little attention in the field of environmental policy technical research. Most of the time, all FDI flows are treated indifferently or distinguished by host economies (Blonigen and Wang 2004). Chapter 2 of this dissertation has proved that the origin-factor of FDI is important to understand how it influences the environment. Different investor groups have different impacts on other countries' economic growth and environmental degradation. The next step is to investigate how FDI from developed countries and FDI from developing countries interact differently with institutional variables to shape the EKC. Second, there are few empirical studies about the influence of domestic factors on pollution in general, and on the environmental abatement tendency of foreign investors in particular. Among institutional variables, corruption, regulation stringency, and rule enforcement have these aspects discussed by several researchers, but rarely in their interaction relationship with FDI. This research comprehensively controls six governance indicators (control of corruption, democracy, political stability, government effectiveness, regulatory quality, and rule enforcement) which are one-by-one tested in their interaction with FDI from the two different sources.

The findings are expected to provide essential policy implications to policymakers and critical contribution to the worldwide discussions on the link between environmental

issues and cross-border investments. Developing governments may archive deeper insights of their country's status into the global matrix, thus finding the way to pursue higher living standards while minimizing the trade-off between prosperity and environmental quality at both the national level and international level. They also understand how their domestic policies are shaping the growth-environment nexus in their countries, thus have more power to control this process.

The following parts of this article are divided as follows: Section 2 covers the literature review. Section 3 explains the methodology and model justifications. Section 4 presents the empirical result and discusses its interpretations. Last, Section 5 interprets conclusions and policy recommendations.

3.2. Literature review

The performance of governments can be measured by many aspects, such as the seriousness of corruption, the extent of democracy, bureaucratic efficiency, the rule enforcement, the quality of policymaking, and political stability. Many international organizations have published various sets of governance indicators to compare institutional qualities among countries. This interest arises from the fact that international agencies want to allocate scarce resources to governments who will utilize them most successfully, or sometimes, who need the most assistance (Kaufmann et al. 1999). It is widely believed that a transparent, democratic and effective regime is more successful in all areas of government, including environment preservation. While democratic and rich European countries have the best records, authoritarian and poor African governments have the worst environmental performance (Almeida and García-Sánchez 2017).

Among international agencies' publishing, the Worldwide Government Indicators database by World Bank is considered as the most comprehensive measurement of governance quality (Apergis and Ozturk 2015). This study utilizes all six institutional variables from the database, namely Control of Corruption (COC), Rule of Law (ROL), Regulatory Quality (RQ), Government Effectiveness (EF), Voice and Accountability (VA), Political Stability (PS). The Control of Corruption index measures public effort to detect and reduce both petty corruption and grand corruption. The Rule of Law index is perceptions of the effectiveness of rule enforcement, including the confidence of authority agents such as the police and the courts, as well as the incidence of crime and the enforceability of contracts. The Regulatory Quality index measures the stringency and soundness of policies and regulations which support the development of the private sector. The Government Effectiveness index is the indicator of public service quality, civil servant competency and their independence from political pressures, as well as the accountability of the government in policy formulation and implementation. The Voice and Accountability index captures various aspects of democracy in the government selection process, civil rights, and the freedom of the media and civil societies. The Political Stability index is the perceptions of the possibilities of an unconstitutional political change, domestic outrage, violence, and terrorism (Buchanan et al. 2012). Although the literature on institutional quality is scattered and each variable can be named or categorized differently by researchers, the following Table 7 provides a summary of existing studies on the role of the six sociopolitical factors of interest in the FDI – environment nexus. There is much evidence that government performance

influences FDI inflow, and sometimes vice versa. Meanwhile, some researchers suggest these indicators have their environmental impact delivered via FDI or other channels.

Table 7. Literature of the institutional variables

Institutional variables	Impact on FDI inflow	Impact on environment	Impact on environment via FDI
Control of Corruption (COC)	Busse and Hefeker (2007) Mengistu and Adhikary (2011) Li et al. (2000) Méon and Sekkat (2005) Mudambi et al. (2013) Cuervo-Cazurra (2006) Asiedu (2006)	Damania et al. (2003) López and Mitra (2000) Apergis and Ozturk (2015) Almeida and García-Sánchez (2017)	Dam and Scholtens (2008) Cuervo-Cazurra (2006)
Rule of Law (ROL) (rule enforcement)	Busse and Hefeker (2007) Mengistu and Adhikary (2011) Asiedu (2006).	Osabuohien et al. (2014)	Kellenberg (2009) Poelhekke and Ploeg (2012)
Regulatory Quality (RQ) (rule/policy stringency and quality)	Busse and Hefeker (2007) Mudambi et al. (2013)	Apergis and Ozturk (2015) Osabuohien et al. (2014)	Dam and Scholtens (2008) Pao and Tsai (2011)
Government Effectiveness (EF)	Busse and Hefeker (2007) Mengistu and Adhikary (2011)	Apergis and Ozturk (2015) Osabuohien et al. (2014)	Pao and Tsai (2011)
Voice and Accountability (VA) (democracy, civil liberties, civil society)	Busse and Hefeker (2007) Jensen (2003) Jakobsen and Soysa (2006) Choi and Samy (2008) Asiedu and Lien (2011)	Almeida and García-Sánchez (2017)	Jorgenson (2009)
Political Stability (PS)	Busse and Hefeker (2007) Mengistu and Adhikary (2011)	Al-Mulali and Ozturk (2015) Taylor (2005) Apergis and Ozturk (2015)	

On the one hand, governance variables directly influence the extent of FDI inflows. Government stability, internal and external conflict, corruption and ethnic tensions, law and order, democratic accountability of government, and quality of bureaucracy are highly significant determinants of foreign investment inflows (Busse and Hefeker 2007). As weak governance increases risks for business; and bribery is like a tax on production (Li et al. 2000), more and more multinational companies (MNCs) are attracted to locations with good institutional qualities. There is evidence that low government performance hinders FDI inflow and vice versa. For instance, corruption has been found to reduce capital accumulation in general (Méon and Sekkat 2005), and negatively affect FDI in particular (Mudambi et al. 2013). It is recommended that countries that are small or lack of natural resources can attract FDI by improving their institutions and policy atmosphere (Asiedu 2006). However, there are more controversies about the role of democracy, regulation and rule enforcement. Jensen (2003) states that developing country democracies receive higher inflows of FDI. Democratic countries are predicted to attract as much as 70 percent more FDI than their authoritarian counterparts. He is supported by Jakobsen and Soysa (2006) who believe that it is fruitful for democracies in the developing world in the globalization era. In contrast, Choi and Samy (2008) argue that democratic hindrance players may acquire a larger increase in FDI. Partly agreeing with both sides, Asiedu and Lien (2011) suggest that democracy promotes FDI only if the proportion of natural resources in total exports is below some critical benchmark. Similarly, for policy and enforcement indicators, the good performance creates stability but increases compliance cost, which is the root cause of the pollution

haven effect as discussed below. By and large, the impacts of domestic factors on FDI flows are substantial but heterogeneous among variables.

On the other hand, domestic factors influence environmental quality. Quite a few scholars acknowledge that cross-border capital is an important channel to deliver the potential environmental impacts of sociopolitical factors. Institutional aspects affect not only the scale but also the greenness of FDI. Weak government performance deepens the pollution haven effect, while good performance enhances the halo effect. *For the pollution haven effect,* there is evidence that firms with weak environmental control are more likely to locate in poor and corrupted countries with less stringent environmental policy, while MNCs with more corporate social responsibility (CSR) consciousness refrain from doing business in those countries (Dam and Scholtens 2008). Furthermore, Kellenberg (2009) highlights that the importance of the enforcement of environmental regulations even outweighs one of policy stringency when companies make relocation decisions to save pollution abatement costs. Although Poelhekke and Ploeg (2012) support this view, they note that there are some industries where better environmental policy and enforcement boost MNCs' reputation for sustainable management and social responsibility. Researching developing countries' perspectives, Pao and Tsai (2011) point out that the pollution haven effect is both an active and passive process. While emerging markets lower their environmental standards and penalties to fuel their growth with larger FDI flows into the manufacturing sector; at the same time, their governments are not able to hold up the enforcement set in policies because of their inadequate institutional resources. *For the halo effect,* it is obvious that FDI inflows to regions with better institutional quality are greener than the flows going to countries with weaker

government performance (Doytch and Uctum 2016). Nevertheless, it is worth to note that even in low environmental requirement markets, many MNCs still maintain their internal environmental control higher than the standards of the host country, or implement voluntary practices such as ISO 14001 (Zeng and Eastin 2012). A possible reason is that they want to build their public image and influence the policymaking process to push domestic standards forward, which in turn heightens their own competitiveness compared to domestic companies and other MNCs with lower technology (Garcia-Johnson 2000). Although there are few scholars examine environmental impacts through FDI channel of other domestic factors, such as civil liberties, government effectiveness, and political stabilities, Jorgenson's paper (2009) suggests these connections are likely to exist. Researching industrial water pollution in less-developed countries, the paper states that stronger participation of civil society organizations and environmental control government agencies is critical to limit the harmful impacts of foreign investment.

As the effect of sociopolitical elements on a researched variables is not always direct and often influenced by other explanatory variables, interaction terms between an institutional variable and an economic indicator are popular to explain the underlying regime (Apergis and Ozturk 2015; Damania et al. 2003; Kwok and Tadesse 2006; Okada and Samreth 2014; Reiter and Steensma 2010; Wang et al. 2013). Governance indicators are often seen to interact with growth rate, FDI, trade openness or each other. Besides, there is evidence that the origin of foreign investors is important in this interactive relationship. Cuervo-Cazurra (2006) reports that corruption not only reduces FDI but also change its origin composition: reducing FDI from countries engaging in laws

against bribery abroad, meanwhile increasing FDI from countries with severe corruption. Those who are used to bribery at home also seek a similar destination abroad. That means corruption does not affect all foreign investors equally. FDI from different countries is affected differently by host country corruption. While all the above-mentioned literature suggests that such interactions between FDI and sociopolitical variables in terms of environmental impacts are likely to exist, neither it is the focus of previous empirical research nor their potential connection with the origin factor of FDI has been addressed except for corruption. Up to the best of the author knowledge, the only existing study employing interaction terms with FDI to test the environmental effect of institutional variables is the paper by Assa (2018), who proves that FDI links to deforestation in Sub-Saharan Africa and this causal relationship is worse in countries with high corruption and low rule regulation. Using the same approach, this study covers a broader set of governance indicators while giving novelty consideration to the differences between the two FDI sources.

3.3. Methodology

The EKC model, which explains the environmental degradation by a function of income and the square of income, will be employed to examine the environmental impacts of corruption and other institutional indicators in the relationship with FDI in developing countries. There are 2 models to perform the task. Both models investigate 23 developing countries from 2001 to 2012. The first model is the basic model, testing the linear relationship among environment degradation, FDI from developing countries, FDI from developed countries, and domestic factors. Other controlled variables are trade openness, population, and industrial employment. The second model is an extension of

the first model to include two interactions terms of an institutional factor with two FDI variables, to find out whether investors from different country groups react differently to domestic factors in terms of environmental issues.

- Model 1 (Basic model):

$$Y_{it} = Ln(CO_2)_{it} = \alpha_0 + \alpha_1 LnGDP_{it} + \alpha_2 (LnGDP_{it})^2 + \alpha_3 LnFDIdved_{it} + \alpha_4 LnFDIdvig_{it} + \alpha_5 TRADE_{it} + \alpha_6 PO_{it} + \alpha_7 INE_{it} + \alpha_{10} X_{it} + u_i + \varepsilon_{it} \quad (2)$$

- Model 2 (Full model):

$$Y_{it} = Ln(CO_2)_{it} = \beta_0 + \beta_1 LnGDP_{it} + \beta_2 (LnGDP_{it})^2 + \beta_3 LnFDIdved_{it} + \beta_4 LnFDIdvig_{it} + \beta_5 TRADE_{it} + \beta_6 PO_{it} + \beta_7 INE_{it} + \beta_8 X_{it} + \beta_9 X_{it}.LnFDIdved_{it} + \beta_{10} X_{it}.LnFDIdvig_{it} + v_i + \varepsilon_{it} \quad (3)$$

In which:

$$FDIdved = \frac{FDI\ stock\ from\ developed\ countries}{Gross\ domestic\ product} x100\%$$

$$FDIdvig = \frac{FDI\ stock\ from\ developing\ countries}{Gross\ domestic\ product} x100\%$$

$$TRADE = \frac{Import+Export}{Gross\ domestic\ product} x100\%$$

X: one of six institutional variables (COC /ROL /RQ /EF/ VA/ PS)

Annual data are obtained for the period between 2001 and 2012 from the World Development Indicators (WDI), UNCTAD, and the Worldwide Governance Indicators (WGI) database. 23 developing countries are Argentina, Armenia, Bangladesh, Bulgaria, Cambodia, China, Croatia, El Salvador, Hungary, Macedonia, Republic of Moldova, Nigeria, Pakistan, Papua New Guinea, Paraguay, Peru, Philippines, Poland, South

Africa, Thailand, Turkey, Uganda, and Ukraine. Although the sample size is limited by the availability of bilateral FDI data published by UNCTAD, it is considered sufficient to deliver statistically meaningful results by panel analysis. The classification of investors into developed and developing groups follows the grouping system of the IMF [2]. Among various country classification systems from different international agencies, the author has considered between the IMF and UN's versions as they are the two most popular grouping catalogs. However, the IMF classification is chosen because it is closer to common perception about who are developed and who are developing countries. Appendix 2 provides country-level information about percentages of FDI inflow stocks from developed and developing regions and leading investors of each group. Among 23 developing countries examined by this study, 13 countries witnessed substantial increases in the proportion of developing partners' FDI stock to the total FDI in the period from 2001 to 2012. While the leading investors could change over the years for each country, they were often economies which have big size, close geographic location and historical relationship with that host country. In some cases, this position may reflect an important economic and politic strategy. For example, the massive investment of China in South East Asian countries, i.e. Cambodia and Philippines, and African countries, i.e. Nigeria and South Africa, may be a part of the Bell and Road Initiative of the Chinese government. The presence of 4 developing EU countries among

[2] The robustness of this study are confirmed with both ways of classifications. Appendix 4 presents the detailed results of the models in the UN grouping setting. The link to the IMF country classification used to classify investor countries can be found at:
https://www.imf.org/external/pubs/ft/weo/2010/02/weodata/groups.htm (World Economic Outlook Database April 2010 – WEO Groups and Aggregates Information). No country has changed its status from a developing to developed economy or vice versa during the studied period from 2001 to 2012.

the studied host economies, namely Bulgaria, Croatia, Hungary, and Poland, is important to justify the possible interactive relationships among the institutional variables and FDI variables. As those countries have relatively good institutional quality, they allow the panel to have wider ranges of governance performance indexes. Thanks to that, interesting insights into how different host country domestic settings can influence the attitude of investors toward environment protection may be revealed[3].

The annual carbon dioxide emission (CO_2) is the most popular proxy of environmental pollution in the EKC literature. GDP denotes the gross domestic product per capita in real terms (in constant 2010 USD). FDIdved and FDIdvig are the FDI inflow stock from developed economies and FDI stock from developing economies as a percentage of national income. FDI stock is preferable than FDI annual flow because it is more stable against the business circle, market fluctuation, and other year specific factors. It also reflects better the real contribution of existing foreign firms in the economies as an investment can circulate and generate profit for its owner in many years. Natural logarithm terms are used to encourage stability in the variance-covariance matrix (Chang et al. 2001). u_i and v_i represent the individual effect of each nation, while ε denotes the random disturbance.

X stands for an institutional variable controlled by the models. There are six institutional variables that will be tested one by one by each model (Control of Corruption - COC, Rule of Law - ROL, Regulatory Quality - RQ, Government

[3] Without the inclusion of the 4 EU developing countries, the estimations do not contradict the findings of this study. However, the interaction terms in Model 2 do not deliver much meaningful implications. That is because the ranges of governance indexes are too narrow to show that good or bad institutional quality can have impact on the FDI variables in terms of environmental performance. For detailed results, please contact the author.

Effectiveness - EF, Voice and Accountability - VA, Political Stability - PS). Therefore, each model has six submodels, denoted from 1.1 to 1.6 for Model 1, and from 2.1 to 2.6 for Model 2. The benchmark of these variables ranges from approximately -2.5 (weak) to 2.5 (strong) governance performance. According to Table 8, the means of all institutional variables are below zero, indicating that most developing countries' governments have weak performance over the research period.

Table 8. Data summary

Variable	Unit	Minimum	First quarter	Median	Mean	Third quarter	Maximum	Standard deviation
CO_2	kiloton	1511	5534	49924	387884	206345	10020745	1404096
GDP	USD	419	1516	3311	4615	6887	14779	3947
FDIdved	%	3.5360	11.0480	17.4730	21.6430	26.8330	83.6800	15.4346
FDIdvig	%	0.1778	2.1530	3.6473	5.8715	7.8161	29.0205	5.9439
TRADE	%	17.4700	43.1400	60.1800	66.6600	87.9800	154.9400	28.9581
PO	million people	2.0430	6.1550	30.3750	99.1900	67.6090	1350.6950	263.6928
INE	%	4.2350	15.4170	20.7530	21.0420	28.0410	36.4270	8.1054
COC		-1.5000	-0.9200	-0.5400	-0.4969	-0.1800	0.7900	0.5342
ROL		-1.4272	-0.8074	-0.5093	-0.4179	-0.0812	0.9977	0.5301
RQ		-1.3520	-0.5340	-0.1050	-0.0608	0.3550	1.3130	0.5719
EF		-1.2146	-0.6903	-0.1763	-0.2151	0.1701	1.0507	0.5290
VA		-1.7490	-0.5644	-0.0811	-0.1275	0.3274	1.1752	0.6412
PS		-2.8100	-0.9925	-0.5000	-0.5159	0.0400	1.2600	0.8033

Besides the main interested variables, there are three additional controlled variables. TRADE represents trade openness as measured by import and export as a proportion of national income. PO is the population. Last, INE denotes industrial employment which is the proxy of the industrialization process reflected by the percentage of employment in industry out of the total employment. These three variables are popular in the EKC literature. The environmental impact of trade openness is a topic of debate, but its

relevance in the EKC model is commonly accepted (Ahmed and Long 2012; Osabuohien et al. 2014). Meanwhile, it is expected that more populated regions with rapid industrialization create more pollution (Plassmann and Khanna 2006). Statistical descriptions of the above-mentioned variables are presented in Table 8 and

Table **9**.

Table 9. Correlations among institutional variables

	COC	ROL	RQ	EF	VA
ROL	0.8975				
RQ	0.8842	0.8728			
EF	0.9089	0.8942	0.8393		
VA	0.7249	0.6953	0.6453	0.6090	
PS	0.6412	0.6359	0.6419	0.5908	0.6089

There are two reasons why all governance variables are not included in a model, but each of them forms a submodel. On one hand, from Table 9, we can see the coefficients of correlations among institutional variables are relatively high, especially among COC, ROL, RQ, and EF. It is obvious that a government with a strong performance in an aspect is likely just as good in other aspects. If all of them are controlled simultaneously, the risk of multicollinearity is substantial, undermining the statistical significance of the regressions. Tarverdi (2018) admits that a combination of several sociopolitical repressors fails to deliver a statistically meaningful result. On the other hand, prior to Tarverdi's paper, Buchanan et al. (2012) combined all indicators into a single variable to avoid this problem. However, the treatment ignores the fact that each indicator is measured independently, and thus produce a different level of influence. To avoid multicollinearity but still capture the unique impact of each domestic factor, they are

treated separately in submodels. All submodels are tested for random effects by the Hausman test. In fact, the fixed effect model is generally considered more suitable for dealing with cross-country regressions. However, the Hausman test is still conducted as a standard test to confirm the model selection. In all submodels, the null hypotheses are rejected. The tests indicate that the fixed effect method is more efficient than the random effect method to estimate these models. Therefore, the selected econometric process is the one-way fixed effect within model.

Table 10. Hausman test

Submodel	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	**1.6**
χ^2	9951.1	283.72	404.52	150.4	196.29	1384.3
p-value	$< 2.2x10^{-16}$	$< 2.2x10^{-16}$	$< 2.2x10^{-16}$	$< 2.2x10^{-16}$	$< 2.2x10^{-16}$	$< 2.2x10^{-16}$
Submodel	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**
χ^2	37.511	114.13	88.203	357.8	312.3	520.68
p-value	$4.616x10^{-5}$	$< 2.2x10^{-16}$	$1.216x10^{-14}$	$< 2.2x10^{-16}$	$< 2.2x10^{-16}$	$< 2.2x10^{-16}$

Model 2 employs interaction terms between the two FDI variables and an institutional variable, X_{it}.LnFDIdved$_{it}$ and X_{it}.LnFDIdvig. An interaction term describes a situation in which the simultaneous influence of two variables on a third is not additive. Interaction terms can greatly expand the understanding of the relationships among the variables in the models. With the presence of interaction terms, coefficients of FDI variables and institutional variables depend on each other. In order to understand how the real coefficients of the FDI variables are changed by an institutional variable, the following partial derivatives of the regressand with respect to the logarithm terms of the two FDI stocks should be computed:

$$\frac{\Delta Y}{\Delta LnFDIdved} = \beta_3+\beta_9 X \quad (4) \qquad \frac{\Delta Y}{\Delta LnFDIdvig} = \beta_4+\beta_{10} X \quad (5)$$

Literally, equation 4 and 5 calculate the percentage change in the level of emissions when there is 1% in the logarithm term of an FDI source. The signs of the partial derivatives reflect the true impacts of the two FDI sources on the environment, taking into account the interaction effect with domestic factors. A positive sign means an increase in the level of carbon dioxide emissions, while a negative sign indicates an improvement of the environmental quality. As a part of the functions, the institutional variables determine the signs of these derivatives.

3.4. Results

3.4.1. Estimations

Model 1 and Model 2 have been tested with the six governance indicators by the one-way fixed effect within model. The estimation results of Model 1 are presented in Table 11. Model 2's results are shown in Table 12, and the analysis of its interaction terms in Table 13.

Table 11. Basic model estimations (Y = $LnCO_2$)

Submodel	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	**1.6**
X	**COC**	**ROL**	**RQ**	**EF**	**VA**	**PS**
LnGDP	2.0748 ***	2.1312 ***	2.0614 ***	2.0757 ***	2.0592 ***	2.0668 ***
$(LnGDP)^2$	-0.0983 ***	-0.1021 ***	-0.0963 ***	-0.0992 ***	-0.0981 ***	-0.0986 ***
LnFDIdved	-0.1571 ***	-0.1567 ***	-0.1523 ***	-0.1590 ***	-0.1605 ***	-0.1592 ***
LnFDIdvig	0.0476 ***	0.0477 ***	0.0488 ***	0.0496 ***	0.0504 ***	0.0501 ***
LnTRADE	0.1836 ***	0.1767 ***	0.1674 ***	0.1781 ***	0.1761 ***	0.1767 ***
LnPO	1.3968 ***	1.4038 ***	1.3673 ***	1.4074 ***	1.4031 ***	1.4096 ***
LnINE	0.0285 *	0.0285 *	0.0275 *	0.0292 *	0.0292 *	0.0292 *
X	-0.0854 *	-0.0581	-0.0793 .	0.0080	0.0102	0.0037
Adjusted R^2	**0.7104**	**0.7066**	**0.7092**	**0.7053**	**0.7053**	**0.7053**

Significance codes: p. < 0.001 '***' p. < 0.01 '**' p. < 0.05 '*' p. < 0.1 '.'

Table 12. Full model estimations (Y = $LnCO_2$)

Submodel	2.1	2.2	2.3	2.4	2.5	2.6
X	**COC**	**ROL**	**RQ**	**EF**	**VA**	**PS**
LnGDP	1.2712 **	1.8134 ***	1.4760 ***	1.3966 ***	1.6381 ***	2.0206 ***
$(LnGDP)^2$	-0.0476 *	-0.0825 **	-0.0577 *	-0.0557 *	-0.0734 **	-0.0919 ***
LnFDIdved	-0.1333 ***	-0.1431 ***	-0.1487 ***	-0.1619 ***	-0.1418 ***	-0.1925 ***
LnFDIdvig	0.0157	0.0431 **	0.0750 ***	0.0664 ***	0.0634 ***	0.0504 ***
LnTRADE	0.1261 **	0.1320 **	0.0949 *	0.1480 ***	0.1655 ***	0.1433 ***
LnPO	1.5365 ***	1.5469 ***	1.4172 ***	1.4475 ***	1.4677 ***	1.3565 ***
LnINE	0.0111	0.0192	0.0144	0.0162	0.0198	0.0221 .
X	-0.0826	-0.0819	0.0614	0.2445 *	0.0633	0.2535 ***
X.LnFDIdved	0.0297	0.0339	-0.0048	-0.0528	0.0097	-0.0644 **
X.LnFDIdvig	-0.1235 ***	-0.0864 ***	-0.1028 ***	-0.1091 ***	-0.0855 ***	-0.0609 ***
Adjusted R^2	**0.7673**	**0.7352**	**0.7530**	**0.7409**	**0.7320**	**0.7485**

Significance codes: p. < 0.001 '***' p. < 0.01 '**' p. < 0.05 '*' p. < 0.1 '.'

Table 13. Interaction term analysis: partial derivatives and their signs

Submodel	2.1	2.2	2.3	2.4	2.5	2.6
X	**COC**	**ROL**	**RQ**	**EF**	**VA**	**PS**
$\frac{\Delta Y}{\Delta LnFDIdved}$	-0.1333	-0.1431	-0.1487	-0.1619	-0.1418	-0.1925-0.0644.PS
Sign	–	–	–	–	–	– (PS > -2.9891: – PS_{min} = -2.8100)
$\frac{\Delta Y}{\Delta LnFDIdvig}$	-0.1235.COC	0.0431-0.0864.ROL	0.075-0.1028.RQ	0.0664-0.1091.EF	0.0643-0.0855.VA	0.0504-0.0609.PS
Sign	COC > 0: – COC < 0: +	ROL > 0.4982: – ROL < 0.4982: +	RQ > 0.7295: – RQ < 0.7295: +	EF > 0.6089: – EF < 0.6089: +	VA > 0.7413: – VA < 0.7413: +	PS > 0.8262: – PS < 0.8262: +

The existence of the EKC is verified in all cases as the coefficients of GDP and GDP square always receive positive and negative signs respectively. While Model 1 confirms the findings of previous research, Model 2 provides more insight into the relationship between governance qualities and the origin factor of FDI. From coefficients which are

significantly different from zero, equations (4) and (5) are used to calculate the derivatives of the regressand with respect to the logarithm terms of the two FDI stocks, and to analyze their signs (Table 13). All submodels have the goodness-of-fit, measured the adjusted R-squared, at around 0.7 for Model 1 and 0.75 for Model 2, implying that approximately 70 to 75% of the total variation in carbon dioxide emissions explained by the regression models. This is a good level for panel data with a wide cross-sectional dimension.

In Model 1, the two FDI sources demonstrate conflicting environmental effects. Among institutional variables, only control of corruption, and regulation quality have a significant linear relationship with the level of pollution. As their coefficients are negative, the improvement of their performance directly connected to the reduction of emissions (Table 11). In Model 2, the findings are interesting. Interaction terms between FDI from developing countries and institutional variables are significant in all submodels, while ones of FDI from developed countries are only confident for political stability (Table 12). The halo effect of FDI from developed countries does not depend on the level of the first five domestic factors. Whereas, the impact of FDI from developing countries strongly interacts with all indicators. For example, if corruption is relatively low, developing-country FDI shows a halo effect. If corruption is relatively high, developing FDI causes more pollution. On one hand, improvement in corruption control enhances the environmental orientation of investors from developing economies. On the other hand, the rise of FDI from developing partners gives the anti-corruption effort more influence on the environmental quality of a host country. The same explanations are applied to rule enforcement, regulation quality, and government efficiency. Only

democracy and political stability can affect the attitudes of both investor groups. If a developing country has relative good governance performance (COC > 0, ROL > 0.4982, RQ > 0.7295, EF > 0.6089, VA > 0.7413, and PS > 0.8062), then investments of developing partners do not pose any threat to the environment (Table 13). Unluckily, most countries in the sample have performance indicators marked below these points during the research period. According to Table 8, the third quarter values of all six institutional variables are smaller than the magnitudes of neutral impact. That means FDI from developing group's investors mostly demonstrated negative influence over the period, which is in line with the results of Model 1 (Table 11). Among 23 countries, developing regions' FDI only showed a halo effect in Poland and Hungary, and neutral environmental impact in Croatia, Turkey, and South Africa. Comparing Model 1 and Model 2, ROL, EF, VA, and PS do not affect pollution directly, but their potential environmental impacts still can be delivered through the FDI variables. This study proves that FDI is an important channel delivering the environmental effect of institutional variables, and the origin factor of FDI is important to understand this dynamic.

3.4.2. Robustness checks

Robustness checks have been conducted in several ways. Appendix 3 presents robustness checks conducted by adding or reducing variables. First, additional variables are gradually reduced until only the core variables of the EKC model and the main variables of interest remain. Reducing variables associates with shrunken goodness-of-fit, but the estimations remain mostly stable. The only minor change is that VA becomes interacting with both FDI variables. Second, Model 1 and Model 2 are tested with a

general institutional quality variable which is the average of the six governance indicators. The general institutional quality variable shows no environmental impact in Model 1 and only interacts with developing-country FDI in Model 2. This is aligned with the key findings, but ignore the differences among six governance indicators. Third, the general institutional quality variable is added into all submodels presented in the text beside each specific domestic indicator. The presence of general institutional quality undermines the confidence of COC and makes RQ become insignificant in Model 1, but brings no change to Model 2. These minor differences do not affect the main conclusions. In addition, the alternative classification of investor countries by UN designation[4] used in Appendix 4 shows very similar results to the main findings. Last, an alternative approach to deal with the developmental stage of the country of origin of FDI is using a variable standing for the average wealth embodied in FDI of its sources. In Appendix 5, instead of FDI stocks from developed and developing economies (FDIdved and FDIdvig), a total level of inward FDI stocks (FDI) and the average GDP per capita of all investor countries weighted by their FDI stocks (IGDP) are employed. A larger value of IGDP would indicate that inward FDI of the country mostly come from high-income countries, while a smaller value would imply the prevalence of low-income investors. The two interaction terms of Model 2 are combined into one between the total FDI variable and one of the six institutional variables (X.LnFDI). The coefficients of LnIGDP are negative in both models, proving again that a richer combination of FDI sources benefits the environment. The total FDI shows a halo effect in Model 1, which is

[4] The UN country classification used to classify investor countries is according to the World Economic Situation and Prospects 2014 report by the United Nations. No country has changed its status from a developing to developed economy or vice versa during the studied period from 2001 to 2012.

reasonable as FDI stocks from developed partners still outweighed ones from developing partners in most countries during the studied period. The interaction term in Model 2 provides more insight. When institutional indicators fall below some benchmarks (except for VA), after controlling for the average wealth of FDI sources, increasing FDI stocks are harmful to the environment. In comparison with Model 1, more institutional variables in Model 2 demonstrate environmental impact through their interaction with FDI, as well as their levels of significance are improved, supporting the conclusion that FDI is an important channel to recognize this effect. By and large, all robustness checks show that the findings of this research are robust against the alternations of model specifications.

3.5. Conclusions

This study indicates that the environmental effect of cross-border investment is influenced by domestic sociopolitical factors, and each investor group reacts to these factors differently. Utilizing the Environmental Kuznets Curve model and interaction terms between institutional variables and FDI variables, the theoretical prediction has been proved. Besides, it shows that the environmental impacts of institutional variables are not always easy to be observed, but became clearer through FDI channels. In the basic model, only two out of six governance indicators significantly correlate with pollution reduction (Table 5). That explains why researchers have not found much empirical evidence of how institutional reform directly reduced pollution. By focusing on the interactive relationship between institutional quality and FDI, this study explains the underlying dynamic, thus makes an original contribution to the existing literature. The most important finding of this chapter is FDI from developing regions is more

sensitive to domestic factors of host countries. Government performance determines whether this FDI source is bad or good for the environment. Meanwhile, the characteristics of FDI from developed nations seem to be relatively neutral to governance indicators. This Chapter 3 agrees with Cuervo-Cazurra (2006) but expands his findings to other institutional variables beyond corruption control.

These results deliver important policy implications to governments in developing countries. First, they could recognize what is the net impact of FDI on their home country environment at their current development status. Second, they should carefully reexamine their FDI-led growth strategies to achieve sustainability. Massive FDI attraction strategy alone is harmful to the environment of their nations. Third, developing governments are empowered that they have inner resources to improve the merits of FDI and reduce its hindrances. Countries should start with institutional reforms to pursue a sustainable development path. Last but not least, better domestic governance is not only important with each country but also helps protect global common by leveling up social responsibilities of MNCs coming from developing regions when they, in turn, become investors outside their borders. The limitation of this study is that it is incapable of fully explaining the reasons determining the difference between FDI from developed countries and FDI from developing countries. FDI origin factor may be the proxy for the investment portfolio, culture, CSR, technology know-how, financial capacity, and management experience, etc. of each group. While it is out of the scope of this research, it could be explored if future firm-level studies are conducted to confirm the key findings of this chapter.

APPENDIX

Appendix 1. List of variables

Variable	Description	Unit	Source
CO_2	The annual carbon dioxide emission	kiloton	World Development Indicators (WDI)
GDP	The gross domestic product per capita in real term	constant 2010 USD	WDI
FDIdved	The annual FDI inflow stock from *developed* economies as a percentage of national income	%	Calculated from UNCTAD bilateral FDI data and WDI gross domestic product data
FDIdvig	The annual FDI inflow stock from *developing* economies as a percentage of national income	%	Calculated from UNCTAD bilateral FDI data and WDI gross domestic product data
TRADE	Trade openness measured by import and export as a percentage of national income	%	WDI
PO	Population	million people	WDI
INE	Industrial employment measured by the percentage of employment in industry out of the total employment	%	WDI
COC	Control of Corruption index		Worldwide Government Indicators (WGI)
ROL	Rule of Law index		WGI
RQ	Regulatory Quality index		WGI
EF	Government Effectiveness index		WGI
VA	Voice and Accountability index		WGI
PS	Political Stability index		WGI
X	An institutional variable, ranging from approximately -2.5 (weak) to 2.5 (strong). In each submodel, X is presented as COC, ROL, RQ, EF, VA or PS.		
$\overline{X}$	General institutional quality measured by an average of the six institutional variables		
FDI	The annual FDI inflow stock as a percentage of national income	%	UNCTAD
IGDP	The weighted average of real GDP per capita of investor countries by FDI inflow stocks, which is calculated by the sum of products between GDP per capita of each investor country and its annual FDI stock in the host country, then divided by the total annual FDI inflow stock of the host country.	constant 2010 USD	Calculated from UNCTAD bilateral FDI data and WDI gross domestic product per capita data

Appendix 2. Country-level FDI information

A: The top *developed* investor country
B: The top *developing* investor country
C: FDI inflow stocks from *developed* countries as a percentage of the total
D: FDI inflow stocks from *developing* countries as a percentage of the total

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Argentina	A	USA		Spain									
	B	Chile			Cayman Islands	Chile			Brazil	Chile		Brazil	Chile
	C	85%	85%	81%	81%	82%	81%	81%	78%	79%	77%	75%	76%
	D	15%	15%	19%	19%	18%	19%	19%	22%	21%	23%	25%	24%
Armenia	A	Greece						Germany	France				
	B	Russia											
	C	68%	71%	66%	66%	70%	68%	44%	31%	32%	37%	34%	32%
	D	32%	29%	34%	34%	30%	32%	56%	69%	68%	63%	66%	68%
Bangladesh	A	The UK											Australia
	B	Saudi Arabia	Malaysia				UAE	Egypt					Malaysia
	C	96%	94%	93%	92%	87%	83%	83%	77%	82%	75%	74%	69%
	D	4%	6%	7%	8%	13%	17%	17%	23%	18%	25%	26%	31%
Bulgaria	A	Germany	Austria								Netherlands		
	B	Turkey		Hungary							Russia		
	C	93%	93%	91%	92%	90%	91%	90%	89%	88%	88%	86%	85%
	D	7%	7%	9%	8%	10%	9%	10%	11%	12%	12%	14%	15%
Cambodia	A	Taiwan							Korea				
	B	Malaysia						China	Malaysia		China		
	C	59%	57%	56%	56%	54%	52%	49%	49%	49%	47%	48%	47%
	D	41%	43%	44%	44%	46%	48%	51%	51%	51%	53%	52%	53%
China	A	USA				Japan							
	B	British Virgin Islands											
	C	92%	91%	90%	89%	88%	86%	84%	83%	83%	82%	83%	83%
	D	8%	9%	10%	11%	12%	14%	16%	17%	17%	18%	17%	17%
Croatia	A	Austria											
	B	Cayman Islands		Hungary									
	C	98%	97%	91%	91%	91%	93%	94%	88%	87%	87%	84%	84%
	D	2%	3%	9%	9%	9%	7%	6%	12%	13%	13%	16%	16%

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
El Salvador	A	USA											
	B	Venezuela			Mexico			Panama					
	C	68%	68%	69%	54%	58%	57%	51%	50%	49%	48%	48%	48%
	D	32%	32%	31%	46%	42%	43%	49%	50%	51%	52%	52%	52%
Hungary	A	Germany											
	B	Russia				Turkey	Malaysia	Russia	Croatia	Russia		Poland	
	C	99%	99%	99%	99%	99%	99%	98%	92%	87%	94%	93%	92%
	D	1%	1%	1%	1%	1%	1%	2%	8%	13%	6%	7%	8%
Macedonia	A	Greece						Netherlands	Greece	Netherlands			
	B	Hungary											
	C	63%	66%	67%	64%	67%	70%	71%	72%	73%	73%	72%	71%
	D	37%	34%	33%	36%	33%	30%	29%	28%	27%	27%	28%	29%
Moldova	A	USA			Spain					Italy	Cyprus	Italy	
	B	Russia											
	C	56%	56%	56%	76%	74%	75%	76%	76%	72%	72%	72%	72%
	D	44%	44%	44%	24%	26%	25%	24%	24%	28%	28%	28%	28%
Nigeria	A	The UK											
	B	China											
	C	29%	29%	29%	29%	29%	29%	29%	29%	29%	75%	73%	50%
	D	71%	71%	71%	71%	71%	71%	71%	71%	71%	25%	27%	50%
Pakistan	A	USA			The UK	USA	The UK						
	B	Saudi Arabia											
	C	67%	60%	70%	68%	80%	66%	69%	71%	63%	65%	73%	73%
	D	33%	40%	30%	32%	20%	34%	31%	29%	37%	35%	27%	27%
Papua New Guinea	A	Australia											
	B	Bahamas											
	C	88%	88%	86%	87%	87%	89%	90%	93%	93%	96%	96%	96%
	D	12%	12%	14%	13%	13%	11%	10%	7%	7%	4%	4%	4%
Paraguay	A	USA											
	B	Argentina	Brazil										
	C	65%	79%	77%	79%	78%	72%	73%	73%	72%	73%	72%	73%
	D	35%	21%	23%	21%	22%	28%	27%	27%	28%	27%	28%	27%
Peru	A	Spain										The UK	
	B	Chile	Panama						Chile				
	C	87%	81%	80%	80%	79%	78%	78%	76%	76%	74%	74%	74%
	D	13%	19%	20%	20%	21%	22%	22%	24%	24%	26%	26%	26%

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Philippines	A	USA											
	B	China											
	C	92%	93%	93%	93%	93%	93%	94%	94%	94%	94%	94%	94%
	D	8%	7%	7%	7%	7%	7%	6%	6%	6%	6%	6%	6%
Poland	A	Netherlands											Germany
	B	Russia						Ukraine			Hungary		
	C	96%	96%	97%	97%	97%	98%	97%	97%	98%	99%	99%	99%
	D	4%	4%	3%	3%	3%	2%	3%	3%	2%	1%	1%	1%
South Africa	A	The UK											
	B	Malaysia			Aruba	Russia	Aruba		China				
	C	94%	89%	89%	89%	91%	93%	93%	87%	88%	90%	91%	91%
	D	6%	11%	11%	11%	9%	7%	7%	13%	12%	10%	9%	9%
Thailand	A	Japan											
	B	Cayman Islands	British Virgin Islands	Cayman Islands		British Virgin Islands		Cayman Islands			Mauritius	Cayman Islands	British Virgin Islands
	C	93%	93%	91%	93%	93%	91%	90%	89%	88%	85%	85%	87%
	D	7%	7%	9%	7%	7%	9%	10%	11%	12%	15%	15%	13%
Turkey	A	Netherlands											
	B	Saudi Arabia	Netherlands Antilles			Russia		UAE					Russia
	C	98%	97%	96%	95%	87%	81%	88%	86%	88%	88%	86%	84%
	D	2%	3%	4%	5%	13%	19%	12%	14%	12%	12%	14%	16%
Uganda	A	The UK											
	B	Kenya											
	C	68%	68%	69%	69%	70%	70%	69%	69%	68%	66%	64%	67%
	D	32%	32%	31%	31%	30%	30%	31%	31%	32%	34%	36%	33%
Ukraine	A	USA				Germany		Cyprus					
	B	Russia											
	C	79%	80%	80%	77%	85%	85%	84%	84%	83%	82%	85%	86%
	D	21%	20%	20%	23%	15%	15%	16%	16%	17%	18%	15%	14%

Appendix 3. Robustness checks by reducing or adding variables

$\overline{X}$: General institutional quality measured by an average of the six institutional variables.

A: Submodels presented in Chapter 3.

B, C: Submodels in which additional controlled variables are reduced.

D: Submodels in which specific institutional variables are replaced by the general institutional variable.

E: Submodels in which the general institutional variable is controlled besides each institutional variable.

Submodel 1.1	**A**	**B**	**C**	**D**	**E**
LnGDP	2.0748 ***	3.4810 ***	3.5785 ***	2.0832 ***	2.0645 ***
$(LnGDP)^2$	-0.0983 ***	-0.1730 ***	-0.1776 ***	-0.0989 ***	-0.0980 ***
LnFDIdved	-0.1571 ***	-0.1392 ***	-0.1395 ***	-0.1560 ***	-0.1592 ***
LnFDIdvig	0.0476 ***	0.0284 .	0.0429 **	0.0473 ***	0.0490 ***
LnTRADE	0.1836 ***	0.2145 ***		0.1786 ***	0.1842 ***
LnPO	1.3968 ***			1.3853 ***	1.4107 ***
LnINE	0.0285 *			0.0285 *	0.0289 *
$\overline{X}$				-0.0558	0.0455
COC	-0.0854 *	-0.0967 *	-0.1064 *		-0.1064 .
Adjusted R^2	**0.7104**	**0.6114**	**0.5804**	**0.7063**	**0.7095**

Submodel 1.2	**A**	**B**	**C**	**D**	**E**
LnGDP	2.1312 ***	3.5532 ***	3.6583 ***	2.0832 ***	2.1215 ***
$(LnGDP)^2$	-0.1021 ***	-0.1777 ***	-0.1829 ***	-0.0989 ***	-0.1013 ***
LnFDIdved	-0.1567 ***	-0.1386 ***	-0.1390 ***	-0.1560 ***	-0.1560 ***
LnFDIdvig	0.0477 ***	0.0284 .	0.0424 **	0.0473 ***	0.0472 **
LnTRADE	0.1767 ***	0.2068 ***		0.1786 ***	0.1774 ***
LnPO	1.4038 ***			1.3853 ***	1.3958 ***
LnINE	0.0285 *			0.0285 *	0.0284 *
$\overline{X}$				-0.0558	-0.0236
ROL	-0.0581	-0.0658	-0.0693		-0.0433
Adjusted R^2	**0.7066**	**0.6066**	**0.5745**	**0.7063**	**0.7055**

Submodel 1.3	A	B	C	D	E
LnGDP	2.0614 ***	3.4095 ***	3.5127 ***	2.0832 ***	2.0568 ***
$(LnGDP)^2$	-0.0963 ***	-0.1667 ***	-0.1715 ***	-0.0989 ***	-0.0961 ***
LnFDIdved	-0.1523 ***	-0.1306 ***	-0.1287 ***	-0.1560 ***	-0.1525 ***
LnFDIdvig	0.0488 ***	0.0300 .	0.0418 **	0.0473 ***	0.0493 ***
LnTRADE	0.1674 ***	0.1894 ***		0.1786 ***	0.1662 ***
LnPO	1.3673 ***			1.3853 ***	1.3695 ***
LnINE	0.0275 *			0.0285 *	0.0275 *
$\overline{X}$				-0.0558	0.0153
RQ	-0.0793 .	-0.1348 **	-0.1483 **		-0.0861
Adjusted R^2	**0.7092**	**0.6165**	**0.5873**	**0.7063**	**0.7080**

Submodel 1.4	A	B	C	D	E
LnGDP	2.0757 ***	3.4277 ***	3.4804 ***	2.0832 ***	2.1340 ***
$(LnGDP)^2$	-0.0992 ***	-0.1701 ***	-0.1718 ***	-0.0989 ***	-0.1022 ***
LnFDIdved	-0.1590 ***	-0.1415 ***	-0.1427 ***	-0.1560 ***	-0.1541 ***
LnFDIdvig	0.0496 ***	0.0311 .	0.0454 **	0.0473 ***	0.0455 **
LnTRADE	0.1781 ***	0.2031 ***		0.1786 ***	0.1837 ***
LnPO	1.4074 ***			1.3853 ***	1.3905 ***
LnINE	0.0292 *			0.0285 *	0.0286 *
$\overline{X}$				-0.0558	-0.0873
EF	0.0080	-0.0440	-0.0837		0.0477
Adjusted R^2	**0.7053**	**0.6058**	**0.5761**	**0.7063**	**0.7058**

Submodel 1.5	A	B	C	D	E
LnGDP	2.0592 ***	3.4564 ***	3.5144 ***	2.0832 ***	2.0392 ***
$(LnGDP)^2$	-0.0981 ***	-0.1722 ***	-0.1744 ***	-0.0989 ***	-0.0952 ***
LnFDIdved	-0.1605 ***	-0.1445 ***	-0.1512 ***	-0.1560 ***	-0.1621 ***
LnFDIdvig	0.0504 ***	0.0321 .	0.0487 **	0.0473 ***	0.0492 ***
LnTRADE	0.1761 ***	0.2047 ***		0.1786 ***	0.1721 ***
LnPO	1.4031 ***			1.3853 ***	1.3500 ***
LnINE	0.0292 *			0.0285 *	0.0282 *
$\overline{X}$				-0.0558	-0.1258
VA	0.0102	0.0225	0.0598		0.0675
Adjusted R^2	**0.7053**	**0.6053**	**0.5753**	**0.7063**	**0.7069**

Submodel 1.6	A	B	C	D	E
LnGDP	2.0668 ***	3.4468 ***	3.5251 ***	2.0832 ***	2.0828 ***
$(LnGDP)^2$	-0.0986 ***	-0.1712 ***	-0.1747 ***	-0.0989 ***	-0.0989 ***
LnFDIdved	-0.1592 ***	-0.1404 ***	-0.1421 ***	-0.1560 ***	-0.1537 ***
LnFDIdvig	0.0501 ***	0.0265	0.0408 *	0.0473 ***	0.0491 ***
LnTRADE	0.1767 ***	0.2130 ***		0.1786 ***	0.1737 ***
LnPO	1.4096 ***			1.3853 ***	1.4121 ***
LnINE	0.0292 *			0.0285 *	0.0282 *
$\overline{X}$				-0.0558	-0.1233
PS	0.0037	-0.0386	-0.0453 .		0.0378
Adjusted R^2	**0.7053**	**0.6082**	**0.5775**	**0.7063**	**0.7067**

Submodel 2.1	A	B	C	D	E
LnGDP	1.2712 **	2.7821 ***	2.8313 ***	1.4260 ***	1.2699 **
$(LnGDP)^2$	-0.0476 *	-0.1279 ***	-0.1295 ***	-0.0551 *	-0.0476 *
LnFDIdved	-0.1333 ***	-0.1438 ***	-0.1428 ***	-0.1622 ***	-0.1337 ***
LnFDIdvig	0.0157	0.0012	0.0087	0.0503 ***	0.0159
LnTRADE	0.1261 **	0.1657 ***		0.1258 **	0.1262 **
LnPO	1.5365 ***			1.4049 ***	1.5387 ***
LnINE	0.0111			0.0139	0.0112
$\overline{X}$				0.1510	0.0079
COC	-0.0826	0.0521	0.0505		-0.0860
COC.LnFDIdved	0.0297	-0.0288	-0.0307		0.0295
COC.LnFDIdvig	-0.1235 ***	-0.1040 ***	-0.1117 ***		-0.1234 ***
$\overline{X}$.LnFDIdved				-0.0552	
$\overline{X}$.LnFDIdvig				-0.1165 ***	
Adjusted R^2	**0.7673**	**0.6540**	**0.6303**	**0.7559**	**0.7663**

Submodel 2.2	A	B	C	D	E
LnGDP	1.8134 ***	3.4272 ***	3.5500 ***	1.4260 ***	1.7160 ***
$(LnGDP)^2$	-0.0825 **	-0.1692 ***	-0.1755 ***	-0.0551 *	-0.0755 **
LnFDIdved	-0.1431 ***	-0.1319 ***	-0.1245 **	-0.1622 ***	-0.1408 ***
LnFDIdvig	0.0431 **	0.0249	0.0344 *	0.0503 ***	0.0403 **
LnTRADE	0.1320 **	0.1784 ***		0.1258 **	0.1327 **
LnPO	1.5469 ***			1.4049 ***	1.5138 ***
LnINE	0.0192			0.0139	0.0178
$\overline{X}$				0.1510	-0.1278
ROL	-0.0819	-0.0603	-0.0863		0.0127
ROL.LnFDIdved	0.0339	0.0164	0.0281		0.0307
ROL.LnFDIdvig	-0.0864 ***	-0.0600 **	-0.0682 ***		-0.0928 ***
$\overline{X}$.LnFDIdved				-0.0552	
$\overline{X}$.LnFDIdvig				-0.1165 ***	
Adjusted R^2	**0.7352**	**0.6189**	**0.5917**	**0.7559**	**0.7369**

Submodel 2.3	A	B	C	D	E
LnGDP	1.4760 ***	2.8079 ***	2.8586 ***	1.4260 ***	1.4905 ***
$(LnGDP)^2$	-0.0577 *	-0.1265 ***	-0.1285 ***	-0.0551 *	-0.0585 *
LnFDIdved	-0.1487 ***	-0.1302 ***	-0.1299 ***	-0.1622 ***	-0.1470 ***
LnFDIdvig	0.0750 ***	0.0572 ***	0.0651 ***	0.0503 ***	0.0727 ***
LnTRADE	0.0949 *	0.1231 *		0.1258 **	0.0987 *
LnPO	1.4172 ***			1.4049 ***	1.4090 ***
LnINE	0.0144			0.0139	0.0136
$\overline{X}$				0.1510	-0.0832
RQ	0.0614	0.0967	0.1262		0.0941
RQ.LnFDIdved	-0.0048	-0.0405	-0.0485		-0.0015
RQ.LnFDIdvig	-0.1028 ***	-0.0962 ***	-0.1005 ***		-0.1067 ***
$\overline{X}$.LnFDIdved				-0.0552	
$\overline{X}$.LnFDIdvig				-0.1165 ***	
Adjusted R^2	**0.7530**	**0.6568**	**0.6339**	**0.7559**	**0.7534**

Submodel 2.4	A	B	C	D	E
LnGDP	1.3966 ***	2.8348 ***	2.9124 ***	1.4260 ***	1.4545 ***
$(LnGDP)^2$	-0.0557 *	-0.1319 ***	-0.1352 ***	-0.0551 *	-0.0581 *
LnFDIdved	-0.1619 ***	-0.1483 ***	-0.1422 ***	-0.1622 ***	-0.1538 ***
LnFDIdvig	0.0664 ***	0.0485 **	0.0591 ***	0.0503 ***	0.0603 ***
LnTRADE	0.1480 ***	0.1778 ***		0.1258 **	0.1568 ***
LnPO	1.4475 ***			1.4049 ***	1.4187 ***
LnINE	0.0162			0.0139	0.0143
$\overline{X}$				0.1510	-0.1599 *
EF	0.2445 *	0.2213	0.1196		0.3409 **
EF.LnFDIdved	-0.0528	-0.0650	-0.0383		-0.0592
EF.LnFDIdvig	-0.1091 ***	-0.1024 ***	-0.1106 ***		-0.1161 ***
$\overline{X}$.LnFDIdved				-0.0552	
$\overline{X}$.LnFDIdvig				-0.1165 ***	
Adjusted R^2	**0.7409**	**0.6385**	**0.6112**	**0.7559**	**0.7458**

Submodel 2.5	A	B	C	D	E
LnGDP	1.6381 ***	2.8451 ***	2.8521 ***	1.4260 ***	1.5785 ***
$(LnGDP)^2$	-0.0734 **	-0.1324 ***	-0.1313 ***	-0.0551 *	-0.0675 **
LnFDIdved	-0.1418 ***	-0.1451 ***	-0.1535 ***	-0.1622 ***	-0.1411 ***
LnFDIdvig	0.0634 ***	0.0435 **	0.0591 ***	0.0503 ***	0.0628 ***
LnTRADE	0.1655 ***	0.1893 ***		0.1258 **	0.1582 ***
LnPO	1.4677 ***			1.4049 ***	1.4004 ***
LnINE	0.0198			0.0139	0.0170
$\overline{X}$				0.1510	-0.2099 *
VA	0.0633	0.3420 **	0.4024 ***		0.1373
VA.LnFDIdved	0.0097	-0.0948 *	-0.1036 **		0.0209
VA.LnFDIdvig	-0.0855 ***	-0.0700 ***	-0.0720 ***		-0.0945 ***
$\overline{X}$.LnFDIdved				-0.0552	
$\overline{X}$.LnFDIdvig				-0.1165 ***	
Adjusted R^2	**0.7320**	**0.6356**	**0.6083**	**0.7559**	**0.7384**

Submodel 2.6	A	B	C	D	E
LnGDP	2.0206 ***	3.3596 ***	3.4862 ***	1.4260 ***	2.0718 ***
$(LnGDP)^2$	-0.0919 ***	-0.1622 ***	-0.1690 ***	-0.0551 *	-0.0936 ***
LnFDIdved	-0.1925 ***	-0.1779 ***	-0.1709 ***	-0.1622 ***	-0.1794 ***
LnFDIdvig	0.0504 ***	0.0283 .	0.0377 *	0.0503 ***	0.0482 ***
LnTRADE	0.1433 ***	0.1748 ***		0.1258 **	0.1302 **
LnPO	1.3565 ***			1.4049 ***	1.3578 ***
LnINE	0.0221 .			0.0139	0.0190
$\overline{X}$				0.1510	-0.2307 **
PS	0.2535 ***	0.2349 **	0.1839 *		0.3082 ***
PS.LnFDIved	-0.0644 **	-0.0697 **	-0.0521 *		-0.0577 **
PS.LnFDIdvig	-0.0609 ***	-0.0672 ***	-0.0769 ***		-0.0704 ***
$\overline{X}$.LnFDIdved				-0.0552	
$\overline{X}$.LnFDIdvig				-0.1165 ***	
Adjusted R^2	**0.7485**	**0.6600**	**0.6335**	**0.7559**	**0.7559**

Significance codes: p. < 0.001 '***' p. < 0.01 '**' p. < 0.05 '*' p. < 0.1 '.'

Appendix 4. Robustness checks with the UN country classification

a. Basic model estimations (Y = $LnCO_2$)

Submodel	1.1	1.2	1.3	1.4	1.5	1.6
X	**COC**	**ROL**	**RQ**	**EF**	**VA**	**PS**
LnGDP	2.1422 ***	2.1992 ***	2.1286 ***	2.1440 ***	2.1394 ***	2.1394 ***
$(LnGDP)^2$	-0.1011 ***	-0.1049 ***	-0.0991 ***	-0.1020 ***	-0.1017 ***	-0.1016 ***
LnFDIdved	-0.1343 ***	-0.1320 ***	-0.1280 ***	-0.1349 ***	-0.1347 ***	-0.1349 ***
LnFDIdvig	0.0336 *	0.0321 *	0.0339 *	0.0348 *	0.0348 *	0.0346 *
LnTRADE	0.1929 ***	0.1861 ***	0.1765 ***	0.1871 ***	0.1867 ***	0.1870 ***
LnPO	1.3463 ***	1.3526 ***	1.3153 ***	1.3550 ***	1.3531 ***	1.3484 ***
LnINE	0.0271 *	0.0271 *	0.0260 .	0.0278 *	0.0277 *	0.0277 *
X	-0.0948 *	-0.0616	-0.0809 .	0.0068	-0.0016	-0.0036
Adjusted R^2	**0.7001**	**0.6953**	**0.6979**	**0.6938**	**0.6938**	**0.6938**

Significance codes: p. < 0.001 '***' p. < 0.01 '**' p. < 0.05 '*' p. < 0.1 '.'

b. Full model estimations (Y = $LnCO_2$)

Submodel	2.1	2.2	2.3	2.4	2.5	2.6
X	**COC**	**ROL**	**RQ**	**EF**	**VA**	**PS**
LnGDP	1.3451 ***	1.8785 ***	1.6648 ***	1.6657 ***	1.9220 ***	2.1784 ***
$(LnGDP)^2$	-0.0502 *	-0.0840 **	-0.0664 **	-0.0701 **	-0.0898 ***	-0.1008 ***
LnFDIdved	-0.1435 ***	-0.1463 ***	-0.1372 ***	-0.1523 ***	-0.1257 ***	-0.1708 ***
LnFDIdvig	-0.0025	0.0266 .	0.0630 ***	0.0469 **	0.0411 *	0.0310 *
LnTRADE	0.1457 ***	0.1638 ***	0.1295 **	0.1749 ***	0.1901 ***	0.1674 ***
LnPO	1.4362 ***	1.4428 ***	1.3012 ***	1.3545 ***	1.4105 ***	1.2885 ***
LnINE	0.0128	0.0202	0.0180	0.0198	0.0213	0.0230 .
X	0.1109	0.0936	0.1938 .	0.3444 **	-0.0032	0.2556 ***
X.LnFDIdved	-0.0368	-0.0220	-0.0552	-0.0966 *	0.0320	-0.0633 **
X.LnFDIdvig	-0.1362 ***	-0.0791 ***	-0.0973 ***	-0.0985 ***	-0.0656 ***	-0.0592 ***
Adjusted R^2	**0.7504**	**0.7138**	**0.7297**	**0.7185**	**0.7059**	**0.7280**

Significance codes: p. < 0.001 '***' p. < 0.01 '**' p. < 0.05 '*' p. < 0.1 '.'

c. Interaction term analysis: partial derivatives and their signs

Submodel	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**
X	**COC**	**ROL**	**RQ**	**EF**	**VA**	**PS**
$\frac{\Delta Y}{\Delta LnFDIdved}$	-0.1435	-0.1463	-0.1372	-0.1523- 0.0966.EF	-0.1257	-0.1708- 0.0633.PS
Sign	–	–	–	– (EF > -1.5766: – EF_{min} = -1.2146)	–	PS > -2.6973: – PS < -2.6973: +
$\frac{\Delta Y}{\Delta LnFDIdvig}$	-0.1385.COC	0.0266- 0.0791.ROL	0.0630- 0.0973.RQ	0.0469- 0.0985.EF	0.0411- 0.0656.VA	0.0310- 0.0592.PS
Sign	COC > 0: – COC < 0: +	ROL > 0.3365: – ROL < 0.3365: +	RQ > 0.6481: – RQ < 0.6481: +	EF > 0.4764: – EF < 0.4764: +	VA > 0.6260: – VA < 0.6260: +	PS > 0.5233: – PS < 0.5233: +

Appendix 5. Robustness checks with the average wealth embodied in FDI of investor countries

(the average GDP per capita of investor countries weighted by FDI stocks)

a. Basic model estimations (Y = $LnCO_2$)

Submodel	1.1	1.2	1.3	1.4	1.5	1.6
X	COC	ROL	RQ	EF	VA	PS
LnGDP	1.7824 ***	1.8933 ***	1.7598 ***	1.7956 ***	1.8212 ***	1.7980 ***
$(LnGDP)^2$	-0.0729 **	-0.0802 **	-0.0699 **	-0.0748 **	-0.0766 **	-0.0746 **
LnFDI	-0.0791 ***	-0.0782 ***	-0.0702 **	-0.0781 ***	-0.0761 **	-0.0790 ***
LnIGDP	-0.4558 ***	-0.4389 ***	-0.4509 ***	-0.4353 ***	-0.4319 ***	-0.4396 ***
LnTRADE	0.2643 ***	0.2527 ***	0.2412 ***	0.2558 ***	0.2571 ***	0.2572 ***
LnPO	1.3264 ***	1.3343 ***	1.2868 ***	1.3320 ***	1.3396 ***	1.3130 ***
LnINE	0.0214	0.0214	0.0197	0.0222 .	0.0221	0.0221
X	-0.1128 **	-0.0968 .	-0.1146 *	0.0042	-0.0298	-0.0152
Adjusted R^2	**0.6979**	**0.6929**	**0.6973**	**0.6890**	**0.6897**	**0.6896**

Significance codes: p. < 0.001 '***' p. < 0.01 '**' p. < 0.05 '*' p. < 0.1 '.'

b. Full model estimations (Y = $LnCO_2$)

Submodel	2.1	2.2	2.3	2.4	2.5	2.6
X	COC	ROL	RQ	EF	VA	PS
LnGDP	1.1981 **	1.5174 **	1.3575 **	1.4814 ***	1.7388 ***	1.7179 ***
$(LnGDP)^2$	-0.0361 .	-0.0556 .	-0.0423 .	-0.0542 *	-0.0708 **	-0.0660 **
LnFDI	-0.1497 ***	-0.1120 ***	-0.0634 **	-0.0902 ***	-0.0790 ***	-0.1142 ***
LnIGDP	-0.3521 ***	-0.3949 ***	-0.4016 ***	-0.4017 ***	-0.3977 ***	-0.3806 ***
LnTRADE	0.2263 ***	0.2413 ***	0.2186 ***	0.2546 ***	0.2519 ***	0.2416 ***
LnPO	1.3298 ***	1.3629 ***	1.2621 ***	1.3400 ***	1.3093 ***	1.2878 ***
LnINE	0.0202	0.0205	0.0188	0.0209	0.0227 .	0.0222 .
X	0.3825 *	0.2074	0.2538 .	0.4141 **	0.0749	0.3157 ***
X.LnFDI	-0.1661 ***	-0.0968 .	-0.1194 **	-0.1363 **	-0.0357	-0.1072 ***
Adjusted R^2	**0.7117**	**0.6955**	**0.7054**	**0.6983**	**0.6894**	**0.7102**

Significance codes: p. < 0.001 '***' p. < 0.01 '**' p. < 0.05 '*' p. < 0.1 '.'

c. Interaction term analysis: partial derivatives and their signs

Submodel	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**
X	**COC**	**ROL**	**RQ**	**EF**	**VA**	**PS**
$\frac{\Delta Y}{\Delta LnFDI}$	-0.1497- 0.1661.COC	-0.1120- 0.0968.ROL	-0.0634- 0.1194.RQ	-0.0902- 0.1363.EF	-0.0790	-0.1142 -0.1072.PS
Sign	COC > -0.9012: − COC < -0.9012: +	ROL > -1.1574: − ROL < -1.1574: +	RQ > -0.5311: − RQ < -0.5311: +	EF > -0.6617: − EF < -0.6617: +	–	PS > -1.0645: − PS < -1.0645: +

CHAPTER 4: Export propensity, informal payment, politician ties, and the Environment Standard Certificates (ESCs) of Vietnamese small and medium enterprises (SMEs)

4.1. Overview

Since the major economic and political reform in 1986 under the name "Doi Moi" (which means Renovation), Vietnam's economy has witnessed fast and remarkable development. The per capita income has risen by more than five times in the last 35 years, to $2,563 in 2018 ($1964 in constant 2010 prices), lifting the country out of the low-income country group (World Bank). Pursuing an export-led growth approach, Vietnam has been actively taking part in the globalization process. Following the diplomatic relation normalization with the United States in 1995, Vietnam became a member of the Association of Southeast Asian Nations (ASEAN) and the Asia-Pacific Economic Cooperation (APEC). Other subsequent remarkable steps are the US–Vietnam Bilateral Trade Agreement in 2000 and Vietnam's membership of the World Trade Organization (WTO) in 2007. As the country has been actively opening up its economy, trade has been playing increasingly important roles in Vietnam's growth regime. Consequently, exports have seen exponential growth from 0.7 billion USD in the 1980s to 243.5 billion USD in 2018, now accounting for 99.4 percent of the GDP (MOIT 2019).

A fundamental force behind the impressive growth of the country is the development of small and medium enterprises (SMEs), who play an important role in increasing the economy's dynamic and effectiveness (Brandt et al. 2016). During the

central planning period, businesses were largely converted into state own enterprises during the postwar economic reconstruction in the late 1970s. Switching its developmental course, Vietnam has introduced policies and legal frameworks for the revitalization of the private sector (Tarp 2018). From the three versions of the Enterprise Law in 1999, 2005 and 2014 to the SME Support Law 2017, the government has demonstrated continuous effort to level the playing field for small and medium participants. As a result, there was a boom in the number of SMEs over the last decade. According to the 2017 Economic Census published by the General Statistics Office of Vietnam (GSO), 98.1 percent of businesses operating in Vietnam are SMEs, which grew 1.5 times since 2012 to 507,860. SMEs are responsible for increasing shares of GDP and employment in the Vietnamese business sector, which steadily rose to about 40 percent and 70 percent respectively over the 2006-2015 period. Including micro firms, these numbers would be even higher (Trinh and Thanh 2017). However, SMEs in Vietnam are still facing many constraints. According to Wignaraja (2013), the top barriers to conducting business in Vietnam perceived by SMEs are credit access, distorted competition, infrastructure, human resource, and corruption. Despite their mounting number, SMEs remain vulnerable because of their small scale, low level of technology and innovation, limited supply chain linkage, lack of financial and marketing support, and thus, narrow entrance to the global market. Overcoming such challenges is essential for the continuous growth of the SME sector, which is the most active part and the major source of job creation in the economy. Among various forms of participation in the global value chain, such as trade, franchising, foreign direct investment, and foreign portfolio investment, export is still the most popular mode of

SMEs' outward international involvement (Zacharakis 1997). Although Vietnamese SMEs' export is now still at a modest level, accounting for under 10 percent of the country's export revenue (Brandt et al. 2016), many scholars and policymakers consider that encouraging international market access is critical to the further development of the SME sector (Le and Harvie 2010; Thai and Chong 2011; Vu and Lim 2013; Vu 2014).

Environmental degradation has become the main challenge to the sustainable development of the Vietnamese business sector in general, and SMEs in particular. Along with growing income, pollution is posing increasing concerns about endangered public health, life quality reduction, shrinking livelihoods, and social unrest. Vietnam ranks 132 out of 180 countries according to the 2018 Environmental Performance Index (EPI), which scores 24 indicators under 10 broader aspects of environmental health and ecosystem vitality. Among the EPI's catalogues, Vietnam's air pollution index is the lowest in the ASEAN region, holding the 161st position. Although Prime Minister Nguyen Xuan Phuc has repeatedly vowed that the country would not exchange environmental quality for economic growth, it is unlikely that the situation will be significantly improved in the near future. On one hand, the pressure on SMEs to adjust their production and management systems to meet environmental obligations is increasing along with the integration process of the economy (Nguyen et al. 2014). On the other hand, their performance regarding this facet remains quite disappointing. Environmental law enforcement remains weak, especially for SMEs. Brandt et al. (2016) highlight that legislation guiding and obliging environmental protection in Vietnam has not focused on smaller entities to the same extent as larger firms yet. At the same time, environmental management is not yet the priority of SMEs, either,

especially when they are short of financial, technical and managerial resources. They often have not only little knowledge and interest in environmental regulations, but also insufficient recognition of associated benefits of pollution control such as enhancing productivity and market access. Likewise, their estimations of the costs and difficulties meeting environmental standards are usually distorted.

In many cases, SMEs' attitudes toward environmental protection could be impeded by corruption. Vietnam has continually ranked low in international evaluations of corruption level, such as the Worldwide Governance Indicators corruption control index and the Transparency International corruptions perceptions index (World Bank 2019). As Vietnam belongs to the East Asian culture where "relationship" highly influences communication patterns of businesses (Yum 1988), bribery is considered as a popular mean of building rapport with civilian officers in order to lessen the burden of dealing with regulations or take advantage of support policies. Although this remark is supposed to be applicable in the case of environmental obligations, very few empirical studies examine the connection between corruption and green compliance by SMEs in Vietnam. This research investigates the ownership of the Environmental Standards Certificate (ESC) in a sample of more than 2600 Vietnamese firms in an SME Survey in 2015. By controlling export propensity, informal payment, and political network as the main independent variables of interest, the research aims to seek insights into how globalization and corruption affect firms' behaviours in their pollution control duties.

4.2. Literature Review

Certification of environmental management has long been considered as a representation of firms' commitment to pollution control practices. Environmental

certificates can be obliged by governments or voluntarily applied by businesses. Most available literature considers voluntary certification. In the case of ESC, as the regulatory enforcement in Vietnam is still weak, and implementing agents have not strictly treated small-scale businesses up to the level of big entities, the adoption of this certificate by Vietnamese SMEs, to some degree, can be regarded as a partly voluntary practice.

There is growing evidence that voluntary standards improve firm performance in terms of revenue, profit, wage, and productivity (Beghin et al. 2015; Martincus et al. 2010; Ni et al. 2019). Such certificates facilitate information exchange between suppliers and buyers regarding non-market characteristics of the product and production process. OECD (2005) highlights that environmental responsibility, as an inevitable component of sustainable development, is increasingly viewed as not only a mere duty but also business merit. Since the awareness of sustainability has been rising, firms can rely on certified environmental standards to heighten their reputation and win consumers' loyalty (Fulponi 2006; Raynolds 2002). Therefore, it could be claimed that certification of environmental control, as long as certification of other standards such as quality or safety, can give substantial market benefit to SMEs (Brandt et al. 2016). The advantage of environmental certificates becomes clearer when firms participate in the internationalization process (Henson et al. 2011). Such factors as increasing profits through product differentiation or improving control and efficiency, which are positive externalities of applying standards (Henson and Caswell 1999; Spence 1976; Tirole 1988), play an important role in attaining and securing international market access (Henson and Humphrey 2010). Especially, for exporters from developing countries,

where institutional qualities remain weak, the effect is even more visible as certified standards can substitute for the home market bias (Co et al. 2017; Henson and Reardon 2005; Goedhuys and Sleuwaegen 2013; Jaffee and Masakure 2005). Therefore, it is arguable that environmental certification is one of facilitators of the global trade, opening advanced markets for small-scale producers in poorer economies (Trifkovic 2015).

However, SMEs in developing countries can reap the benefits of environmental standards only if they can overcome the cost of compliance (Maskus et al. 2013). In order to obtain certificates, firms must adapt and document their production process, technology level, and managerial control system to meet the requirements of certifying bodies, following by regular audits and inspections. This can be a costly and complicated procedure, especially for small and medium businesses (Henson and Humphrey 2010). If the implementation costs of standards escalate, compensation for additional investments may erode positive profit and productivity effects (Trifkovic 2016). In some cases, the adoption of certificates is proven to counteract export performance (Bontemps et al. 2012; Schuster and Maertens 2015).

While the effect of environmental certification on SMEs' export is not always parallel, there is also complexity in the corruption – firm performance nexus, which is often mentioned as the debate between the so-called "sand in the wheels" and "grease in the wheels" hypotheses. Advocates of the "sand in the wheels" premise regard informal payments to government officers as additional costs to conduct business, thus impairing the efficiency of the economy (Fisman and Svensson 2007; O'Toole and Tarp 2014). Paunov (2016) claims that such a negative impact is even stronger for smaller firms.

Meanwhile, the "grease in the wheels" camp argues that bribery speeds up transactions and bridges inefficient gaps in poor institutional backdrops (Mendoza et al. 2015; Vial and Hanoteau 2010). So far, studies into the impact of corruption on the Vietnamese SME sector also have contradictory results, which support both sides of the argument (Maruichi and Abe 2018; Nguyen et al. 2016).

Despite the debate on the linkage between corruption and firm performance, scholars generally agree that rent-seeking behaviours are harmful to environmental control practices of businesses. There is handsome evidence that in a weak institutional context where corruption is rampant, it is popular for businesses to resort to bribery instead of obeying environmental regulations (Berliner and Prakash 2013; Desai 1998; Pellegrini and Gerlagh 2006; Smith et al. 2003). For this reason, many scholars highlight the role of private certification in overcoming information asymmetries in corrupt regimes (Montiel et al. 2012). However, the other side of the coin, why domestic standards appear to be less trustworthy, is rarely investigated with empirical evidence. While voluntary certification attracts most research attention, the linkage between bribery and domestic standards is largely unexplored. Moreover, in the context of SMEs' involvement in global trade, the complexity among informal payments, obliged environmental standards and export performance lays down an interesting but mostly overlooked research topic. This research seeks answers to how much reliable legally required environmental certification is in a high corrupt developing country, and to what extent such standards still preserve market advantage for SMEs' export activities. To the best of the author's knowledge, the study by Ho (2015) is the only paper pointing out empirical evidence that informal payments relate to a higher rate of

domestic environmental certification in the Vietnamese SME sector, which analyzes data from SME surveys in 2007 and 2009. Utilizing a newer data set, this study reinvestigates the impact of corruption as a determinant of environmental compliance with a closer focus on the corruption – domestic environmental certification – trade activity nexus.

4.3. Methodology

The 2015 Vietnamese SME survey (Brandt et al. 2016) is the sixth round in the biannual collaborative survey series by The United Nations University World Institute for Development Economics Research (UNU-WIDER), the University of Copenhagen, the Ministry of Labour, Invalids and Social Affairs (MOLISA) of Vietnam, and the Central Institute of Economic Management (CIEM). The survey includes over 2600 SMEs in the manufacturing sector in 3 big cities (Ha Noi, Hai Phong, and Ho Chi Minh City) and 7 provinces of Vietnam (Phu Tho, Nghe An, Quang Nam, Khanh Hoa, Lam Dong, Long An, and the former Ha Tay, which became a part of Hanoi since 2008). This joint research effort aims to collect data representing the dynamics of the Vietnamese private sector. Therefore, not only formally registered or high-profile firms but also a large number of household businesses, either formal or informal, were investigated. With 134 questions in the main questionnaire for enterprises, the survey covers various firm performance and business environment aspects, such as size, profit, productivity, export, formalization, environment practices, informal payments, finance, investment, technology, labour force, access to facilities and services, innovation, networks, managerial personality, sale, etc. The sample consists of domestic non-states manufacturing enterprises, which have registered capital neither from central

government or provincial funding nor from foreign investors. The sample selection follows the practices set up in former survey rounds, dating back to 2005. Surviving businesses were re-interviewed every round, while new companies were added to replace exiting firms.

The survey, so far, is the biggest record of the Vietnamese SMEs' performance including environmental management criteria. The stewardship of Environmental Standards Certificates (ESCs) is employed as a proxy for environmental compliance. Firms were required to show their ESCs to prove their ownership of the certificates. ESCs were used as a pollution control instrument in Vietnam in the period from 1996 to 2015. The certificates were first postulated under the Circular 2781/TT-KCM in 1996 of Ministry of Natural Resources and Environment, then repeatedly referred in the Law on Environmental Protection 2005, Decree 80/2006/ND-CP guiding the above law implementation, Decree 29/2011/ND-CP detailing and guiding a number of articles of the Law, and Degree 179/2013/ND-CP specifying financial penalties for breaking environmental regulations. As ESCs are not mentioned anymore in Degree 18/2015/ND-CP, which replaces Decree 29/2011/ND-CP, ESCs were gradually substituted by other environmental regulatory instruments. However, existing ESCs are still effective until their expiry, which is 3 or 5 years after granted, depending on production activity.

The question about the ownership of ESCs has a "Yes" or "No" answer, i.e. firms stated that they were having ESCs or not. As this regressand (Y = ESC) is a binary variable, probit or logit models are orthodox methods to estimate models with binary outcomes. Logit and probit regressions result in more efficient estimations in this case,

while OLS is rather misleading (Gujarati 2009). The choice between logit or probit largely depends on the personal preferences of researchers. In this study, the probit model will be employed to test the ESC compliance against control variables. In the probit model, we assume that there is a latent variable Y* such that:

$Y^* = X'\beta + \varepsilon$, where $\varepsilon \sim N(0,1)$

$y_i = 0$ if $y_i^* \leq 0$, $y_i = 1$ if $y_i^* > 0$

That means the real explained variable Y (i.e. the ownership of ESCs) can be seen as an indicator for whether the auxiliary variable is positive. X is the matrix of control variables. The main independent variables of interest are the export propensity (EX), profit per capita (P), distance to the main customer (DIS), informal payment (IP), political network (PON), and environmental law awareness (AW). Other control variables are the firm size (SZ) and dummies of the household business (HH), urban location (UR), industrial zone (IZ), and manufacturing sectors. Except for the profit per worker, distance to the most important client, civil servant linkage and firm labour force size, the regressand and the rest of regressors are binary variables.

The inclusion of both IP and PON can deliver interesting insights into the relationship between businesses and government officials. Some might concern that the control of the informal payment and political network variables may cause a multicollinearity problem in the model. The author argues that the issue is minor because IP and PON are different types of variables. First, IP is binary while PON is measured by the number of contacts. Therefore, the possibility that there is a highly linear relationship between the two regressors, which is the origin of a multicollinearity matter, is low. Second, the implications of IP and PON do not totally overlap. While IP

directly addresses corruption, linkage with civil servants can have both positive and negative implications. On the one hand, firms who connect with more officials tend to give more bribes, especially when that practice is considered as a popular way to maintain rapport with local governments. On the other hand, the politician network is important for businesses to enjoy better legal support and law knowledge. The influence of multicollinearity will be examined later in this chapter by robustness checks.

The probit model will be adjusted for clustered standard errors. Clustered standard errors occur when there are clusters in the data set, where observations within each cluster are correlated as they share an identical individual characteristic, such as capacity or socioeconomic context. For survey data, the justification for clustering should be based on the sampling design (Abadie et al. 2017). As the stratified sampling method was implemented to cover a sufficient number of businesses in each type of ownership in the 2015 Vietnamese SMEs survey (Brandt et al. 2016), clustered standard errors will be adjusted for firm legal structure in this study. There are 5 clusters, equivalent to 5 ownership forms, namely limited liability company, joint-stock company, collective, sole proprietorship, and household business.

In the probit model, instead of interpreting coefficients, we concern about marginal effects, which capture how much the conditional probability of the outcome variable changes when the value of a regressor is changed, holding all other regressors constant at some values. Therefore, after the computation of the regression fit, there is an additional step of computing marginal effects. The full model which including all variables will be regressed for the whole sample. After that, the sample will be divided into subsamples by the export propensity, informal payment involvement, and

environmental law awareness. Then, probit regressions will be run again for the three pairs of subsets, dropping the variable used as a division criterion in each case. In the export subset, because only 14 out of 185 export companies are household businesses, the inclusion of the household dummy has little meaningful contribution to the model and cannot be calculated by STATA. Therefore, the household dummy is dropped for this subsample.

4.4. Results

4.4.1. Mean differences

Table 1 presents the means of continuous variables and proportions of the likelihood that binary variables receive value 1 in the whole sample and subsets. The significance levels of the mean comparison t-test for each pair of subsets are also reported. In the whole sample, also the adoption of ESCs is obliged by law, only 13.4% of SMEs obtained the certificates. The average environmental law awareness is also low, with 16.9% of businesses have fair or good knowledge of regulations. Meanwhile, informal payment involvement is quite popular, with 43.1% of the sample admitted to paying bribes. The mean comparisons in pairs of subsets reveal more information about firm dynamics. In most cases, the p-value of the mean comparison t-test is less than 0.01, rejecting the null hypothesis that there is no difference between the means of the same variables in each pair of subsamples. The significance levels are 0.05 for the profit per capita in the informal payment/ no informal payment subsets, and the average distance to the major client in the high/ low law awareness subsets. However, no statistically meaningful difference is found in profit levels of export and non-export firms.

Table 14. Means of continuous variables and occurrence rates of binary variables in the whole sample and subsets, with significance levels of the mean comparison t-test for each pair of subsets.

Variables	Unit	Whole sample	ESC=1	ESC=0	t-test	EX=1	EX=0	t-test	IP=1	IP=0	t-test	AW=1	AW=0	t-test
Y = ESC		13.4%				45.4%	11.0%	***	23.5%	5.8%	***	32.0%	9.6%	***
EX		7.1%	24.0%	4.5%	***				13.2%	2.5%	***	17.5%	5.0%	***
P	Billion VND	0.068	0.098	0.063	***	0.085	0.067		0.080	0.059	**	0.097	0.062	***
DIS	1000 km	0.039	0.095	0.029	***	0.159	0.030	***	0.054	0.027	***	0.054	0.036	**
IP		43.1%	75.2%	38.1%	***	80.0%	40.3%	***				68.4%	38.0%	***
PON	No. of contacts	1.625	2.485	1.486	***	2.319	1.572	***	2.099	1.267	***	2.445	1.459	***
AW		16.9%	40.7%	13.2%	***	41.6%	15.0%	***	26.8%	9.4%	***			
SZ	No. of workers	14.140	44.345	9.309	***	65.530	10.220	***	23.390	7.144	***	33.490	10.220	***
HH		62.8%	13.4%	70.6%	***	7.6%	67.1%	***	38.2%	81.5%	***	28.9%	69.7%	***
UR		44.6%	66.6%	41.2%	***	64.3%	43.1%	***	70.9%	24.7%	***	71.8%	39.1%	***
IZ		4.3%	13.6%	2.8%	***	15.7%	3.4%	***	7.0%	2.2%	***	9.6%	3.2%	***
Obs.		**2,610**	**350**	**2260**		**185**	**2,425**		**1,125**	**1,485**		**440**	**2,170**	

Significance codes: p. < 0.01 '***' p. < 0.05 '**' p. < 0.1 '*'

Between ESC owners and the rest, ESC adopted firms have better performance in all aspects. They often have a higher profit per capita and appear more active in reaching foreign markets and further domestic customers. The rate of firms involving internationalization is 5 times higher than the group without ESC ownership, 24% versus 4.5%. They are also more likely to be non-household businesses which have a bigger size with more employees, and usually located in major urban areas and/or industrial zones. Although they unsurprisingly have better environmental law awareness, they have a more tendency to involve in bribery and maintain close contacts with government officials.

4.4.2. Estimations

Although the mean comparison gives us a broad image/impression of the dynamic among ESC compliance, corruption and export performance, it does not explain the influence of each control variable on the ownership of ESCs. The following tables present the marginal effects of the probit model for the whole sample, together with outcomes of comparable regressions run for each pair of subsamples. Overall, firms are more likely to obtain ESCs if they involve in export or trade with partners in further locations. At a significance level of 10%, there is evidence that ESCs encourage a better profit per worker. Besides, informal payments and relationships with civil servants are proven to improve the chance of obtaining ESCs. The environmental law knowledge, firm size, and household dummy are important determinants of the obliged certification, which are consistently significant across models. As law enforcement has not strictly targeted smaller firms, many household businesses avoided the procedure to attain ESCs. Thus, the household dummy is negative in the whole model and all submodels.

Although more firms in big cities and industrial parks have ESCs, there is no clear trend that such location factors always decide the rate of certification as the estimations of these dummy variables are inconsistent. They are significant in some subsets, but insignificant in the other cases.

Table 15. Marginal effects of probit estimations for the whole sample and the export/non-export subsets

VARIABLES	Whole sample	Export subset	Non-export subset
Export propensity (EX)	0.0468*		
	(0.0250)		
Profit per capita (P)	0.0201*	0.7849**	0.0120*
	(0.0108)	(0.3243)	(0.0067)
Distance to the main customer (DIS)	0.0646***	0.1188***	0.1085***
	(0.0249)	(0.0385)	(0.0136)
Informal payment (IP)	0.0389***	0.2755***	0.0306***
	(0.0109)	(0.0658)	(0.0117)
Political network (PON)	0.0042***	0.0374***	0.0023*
	(0.0013)	(0.0110)	(0.0013)
Law awareness (AW)	0.0489***	0.0282	0.0471***
	(0.0130)	(0.0819)	(0.0161)
Size (SZ)	0.0007***	0.0017***	0.0007***
	(0.0001)	(0.0004)	(0.0001)
Household business (HH)	-0.1859***		-0.1666***
	(0.0218)		(0.0233)
Urban location (UR)	0.0101	0.1723***	0.0053
	(0.0139)	(0.0546)	(0.0149)
Industrial zone (IZ)	0.0237***	0.0788	0.0285***
	(0.0063)	(0.0763)	(0.0065)
SECTOR DUMMIES	YES	YES	YES
Observations	2,610	185	2,425
Log likelihood	-725.7	-101.0	-616.5
Pseudo R^2	0.295	0.207	0.265

Standard errors in parentheses, adjusted for 5 clusters by firm types
Significance codes: p. < 0.01 '***' p. < 0.05 '**' p. < 0.1 '*'

Table 16. Marginal effects of probit estimations for the whole sample and the informal payment/ no informal payment subsets

VARIABLES	Whole sample	Informal payment subset	No informal payment subset
Export propensity (EX)	0.0468*	0.1564***	-0.0252***
	(0.0250)	(0.0330)	(0.0026)
Profit per capita (P)	0.0201*	0.0612***	0.0039
	(0.0108)	(0.0221)	(0.0033)
Distance to the main customer	0.0646***	0.1501***	0.0158
(DIS)	(0.0249)	(0.0378)	(0.0152)
Informal payment (IP)	0.0389***		
	(0.0109)		
Political network (PON)	0.0042***	0.0092***	-0.0000
	(0.0013)	(0.0027)	(0.0007)
Law awareness (AW)	0.0489***	0.0888***	0.0307***
	(0.0130)	(0.0139)	(0.0100)
Size (SZ)	0.0007***	0.0008***	0.0015***
	(0.0001)	(0.0001)	(0.0002)
Household business (HH)	-0.1859***	-0.2318***	-0.0940***
	(0.0218)	(0.0087)	(0.0280)
Urban location (UR)	0.0101	0.0299**	0.0001
	(0.0139)	(0.0123)	(0.0148)
Industrial zone (IZ)	0.0237***	0.0149	0.0531
	(0.0063)	(0.0321)	(0.0462)
SECTOR DUMMIES	YES	YES	YES
Observations	2,610	1,125	1,485
Log likelihood	-725.7	-483.2	-213.1
Pseudo R^2	0.295	0.212	0.351

Standard errors in parentheses, adjusted for 5 clusters by firm types
Significance codes: p. < 0.01 '***' p. < 0.05 '**' p. < 0.1 '*'

Table 17. Marginal effects of probit estimations for the whole sample and the high law awareness/ low law awareness subsets

VARIABLES	Whole sample	High law awareness subset	Low law awareness subset
Export propensity (EX)	0.0468*	0.1344	0.0294**
	(0.0250)	(0.1148)	(0.0137)
Profit per capita (P)	0.0201*	0.1226	0.0103
	(0.0108)	(0.0943)	(0.0094)
Distance to the main customer (DIS)	0.0646***	0.0652	0.0623**
	(0.0249)	(0.1062)	(0.0250)
Informal payment (IP)	0.0389***	0.0487*	0.0365***
	(0.0109)	(0.0281)	(0.0113)
Political network (PON)	0.0042***	0.0144***	0.0002
	(0.0013)	(0.0045)	(0.0012)
Law awareness (AW)	0.0489***		
	(0.0130)		
Size (SZ)	0.0007***	0.0015*	0.0005***
	(0.0001)	(0.0008)	(0.0001)
Household business (HH)	-0.1859***	-0.2284***	-0.1813***
	(0.0218)	(0.0283)	(0.0212)
Urban location (UR)	0.0101	0.0879***	-0.0011
	(0.0139)	(0.0306)	(0.0109)
Industrial zone (IZ)	0.0237***	-0.0482	0.0390***
	(0.0063)	(0.0648)	(0.0124)
SECTOR DUMMIES	YES	YES	YES
Observations	2,610	440	2,170
Log likelihood	-725.7	-217.5	-493.5
Pseudo R^2	0.295	0.212	0.282

Standard errors in parentheses, adjusted for 5 clusters by firm types
Significance codes: p. < 0.01 '***' p. < 0.05 '**' p. < 0.1 '*'

Export and non-export subsets are reported in Table 15. For SMEs who export, there is more convincing evidence of a link between corruption and ESCs. Both the magnitudes of IP and PON's marginal effects are higher in this subgroup. PON is

estimated with a higher confidence level than the non-export case. The subset also witnesses a clearer association between profit gain and the adoption of ESCs. Meanwhile, the understanding of environmental law does not affect much the export firm's decision of applying for ESCs. On the contrary, law-awareness is an important determinant in the non-export subgroup. It can be argued that export activity is the strongest driver of ESC ownership for these firms, regardless of their interest in regulations, for which they might manage with under-the-counter deals with officials.

The informal payment/ no informal payment subsets are the focus of Table 16. Surprisingly, when businesses do not pay informal payments, their internationalization activity or distance to the major customer do not encourage higher ESC compliance. profit per capita and political ties are also insignificant for this subgroup. As free-of-bribery export firms have a smaller size than the average of all export SMEs (48.22 versus 65.53 workers), they may escape from the scrutiny of local governors. They maintain a smaller number of contacts with civil servants than the whole sample mean (0.973 versus 1.625 contacts). If the process of applying for ESCs is complicated with informal cost, they may avoid both informal payment and certification. Moreover, bribery-free companies do not enjoy the pro-profit effect of ESCs. A possible reason could be the high cost of standard compliance these firms had to pay when they obtained ESCs without bribing officials. Therefore, the only inducements for these firms to comply with the obligated certificate relied on their size and law awareness. In contrast, the informal payment group witnesses a positive correlation between the ESC ownership and all major explanatory variables.

Last, Table 17 presents the marginal effect estimations for the high and low environmental law awareness subsets in comparison with the whole sample. Foreign market access and the location of the main customer positively influence the adoption of ESCs among firms with lower law understanding. It seems that customer perception is an important source of encouragement for standard adoption when the businesses themselves lack interest in environmental regulations. Meanwhile, high awareness firms' decision to obtain ESCs does not depend on the demand of overseas and domestic clients. Actually, this is a positive sign as it suggests that internationalization and sale expansion tendency can somewhat compensate for law awareness in heightening the rate of standard compliance. Even if firms are not legally knowledgeable, they will be still conscious of the merit of certification in gaining market access. Informal payment is significant for both subsets, but the significance level is stronger for SMEs with less law understanding. Although the ratio of businesses involving in bribery is higher in the former subset, that may reflect the fact that firms are often big enterprises with a greater export tendency. However, there are undeniable warning signs that giving brides leads to higher ownership of ESCs in both groups. A potential explanation is that bribery might have become a common practice in the ESC application process, in which informal payments are often expected by civil servants. In that case, even law well-informed companies would be willing to pay the hidden cost to avoid a time-consuming and troubling endorsement process. This is problematic because businesses will be more likely to pay officials to obtain ESCs without proper effort to renovate their production and report systems, even if they have enough

knowledge about environmental regulations. There may be a gap between the law awareness level and the real commitment to pollution control.

4.4.3. Robustness checks

As mentioned above, in order to resolve the concern about the possible multicollinearity problem caused by the inclusion of both informal payment and political linkage in the model, robustness checks are conducted. The model is run again twice for the whole sample and the three pairs of subsamples; each time, either the political network (Appendix 6) or informal payment variable (Appendix 7) is dropped. The robustness checks show that changes in magnitudes and significance levels of all marginal effects are minor in both cases. There is no objection to the main interpretations of the original model. In other words, as predicted, multicollinearity is not a serious issue in this study.

4.5. Conclusions

To sum up, the case of ESC ownership in the Vietnamese SME sector is rather thought-provoking as it lies on the thin line between an obliged environmental management instrument and a voluntary practice. Although the adoption of ESCs was specified by law, the weak implementation and rampant corruption allow firms to either avoid compliance or manage to buy a green outfit with bribery. While quite a few companies used ESCs to make up their profile for customers, especially those who were in distant locations and not be able to observe the on-the-ground process, there is worrying evidence that corruption might interfere in the certification process. The finding of this study that export encouraged the domestic environmental management certification in Vietnam does not contradict the remark that trade negatively affects low

institutional quality countries in the previous chapters. The reason is that ESCs in Vietnam may not reflect the true level of green practices embraced by SMEs when informal payments and relationships with public servants get in the way. Firms might pay officers to obtain ESCs without seriously improving their environmental management. That means export can increase the rate of ESCs application but not really raise the environmental awareness of firms. Even though ESCs are not in use anymore, the research questions the true level of environmental commitment to obliged pollution control measures in developing economies with high corruption profiles.

This study contributes to the literature by empirically exploiting the dynamic among corruption, domestic environmental certification and firm performance of Vietnamese SMEs. Interestingly, the findings support both sides of the argument between "sand in the wheels" and "grease in the wheels", depending on the point of view. To some extent, domestic environmental standards still have properties in communicating non-market features of the production process to customers, similar to the merit of voluntary certification which are well-defined by previous researchers. On the one hand, when firms pay informal payments and make corrupt use of their relationship with government officials to obtain certificates, this act seems to put grease in the wheels of commerce, facilitating them to reach export markets or further native buyers. On the other hand, as bribery becomes a widespread unofficial tax (Wunder 2006) on the standard adoption procedure, it might prevent small size enterprises who are overlooked by the weak rule enforcement from applying for such certification, like the outcome of the no informal payment subset. Anyway, both cases are problematic in the long run.

The trust of customers will be deteriorated over time if they realize that the suppliers have not actually invested in environmental facilities. Foreign buyers, especially those from advanced markets with greater concern on the environment and sustainability, may lose faith in the home country certification system. Thus, the export of not only firms with dishonest practices but also SMEs who genuinely participated in certification programs will be affected. Moreover, if paying informal payment to adopt environmental standards becomes popular, more and more firms will be discouraged to authentically apply for the standard, and more and more officers will look forward to receiving under-the-counter commissions to handle such applications. In the end, the effectiveness of certification will be worsened for the whole country. Last but not least, businesses will lose the legal incentive to innovate their production system toward a leaner and greener process. This situation is a vicious circle. The country will slip further from its sustainability targets and not be able to escape from the doubtful impressions of oversea clients. In the end, gain in the short term of a handful of opportunistic firms may result in a greater loss for the whole economy in the globalization era.

By and large, this research underlines the role of transparency in improving the true environmental commitment of SMEs, which will, in turn, benefits their images when they reach international customers or expand their domestic markets. Good standard certification implementation must be accompanied by a credible audit system. Besides, as a higher law awareness will encourage SMEs in embracing obliged standards regardless of market incentives, policymakers should provide environmental law training and support that are essential to induce sustainability in the development and

internationalization of the SME sector. This study gives a striking example of the interdependent relationship among trade, institutional quality, and environmental management. Though only corruption is discussed, the work paves the way for further research on other elements of governance performance in the same complexity.

APPENDIX

Appendix 6. Robustness checks – Models without the political network variable (PON)

VARIABLES	Whole sample	Export subset	Non-export subset	Informal payment subset	No informal payment subset	High law awareness subset	Low law awareness subset
Export propensity (EX)	0.0481*			0.1605***	-0.0252***	0.1436	0.0294**
	(0.0253)			(0.0336)	(0.0026)	(0.1117)	(0.0137)
Profit per capita (P)	0.0208*	0.8214***	0.0126*	0.0660***	0.0039	0.1459	0.0103
	(0.0111)	(0.3064)	(0.0071)	(0.0249)	(0.0032)	(0.0939)	(0.0095)
Distance to the main customer	0.0638**	0.1242***	0.1086***	0.1478***	0.0158	0.0635	0.0622**
(DIS)	(0.0249)	(0.0335)	(0.0135)	(0.0378)	(0.0152)	(0.1063)	(0.0250)
Informal payment (IP)	0.0420***	0.3050***	0.0322***			0.0674**	0.0367***
	(0.0111)	(0.0666)	(0.0120)			(0.0330)	(0.0112)
Political network (PON)							
Law awareness (AW)	0.0531***	0.0659	0.0494***	0.0996***	0.0307***		
	(0.0129)	(0.0769)	(0.0153)	(0.0148)	(0.0100)		
Size (SZ)	0.0007***	0.0017***	0.0008***	0.0008***	0.0015***	0.0016**	0.0005***
	(0.0001)	(0.0004)	(0.0001)	(0.0001)	(0.0002)	(0.0008)	(0.0001)
Household business (HH)	-0.1868***		-0.1669***	-0.2324***	-0.0940***	-0.2268***	-0.1815***
	(0.0220)		(0.0240)	(0.0097)	(0.0279)	(0.0284)	(0.0211)
Urban location (UR)	0.0091	0.1488**	0.0048	0.0272**	0.0001	0.0876***	-0.0012
	(0.0143)	(0.0610)	(0.0151)	(0.0136)	(0.0147)	(0.0311)	(0.0109)
Industrial zone (IZ)	0.0211***	0.0351	0.0271***	0.0069	0.0531	-0.0675	0.0390***
	(0.0042)	(0.0733)	(0.0064)	(0.0298)	(0.0461)	(0.0558)	(0.0126)
SECTOR DUMMIES	YES	YES	YES	YES	YES	YES	YES
Observations	2,610	185	2,425	1,125	1,485	440	2,170
Log likelihood	-727.6	-103.4	-617.2	-485.1	-213.1	-219.2	-493.5
Pseudo R^2	0.293	0.189	0.264	0.209	0.351	0.206	0.282

Standard errors in parentheses, adjusted for 5 clusters by firm types
Significance codes: p. < 0.01 '***' p. < 0.05 '**' p. < 0.1 '*'

Appendix 7. Robustness checks – Models without the informal payment variable (IP)

VARIABLES	Whole sample	Export subset	Non-export subset	Informal payment subset	No informal payment subset	High law awareness subset	Low law awareness subset
Export propensity (EX)	0.0540**			0.1564***	-0.0252***	0.1397	0.0363***
	(0.0250)			(0.0330)	(0.0026)	(0.1173)	(0.0117)
Profit per capita (P)	0.0198**	0.7094**	0.0116**	0.0612***	0.0039	0.1108	0.0113
	(0.0098)	(0.3297)	(0.0056)	(0.0221)	(0.0033)	(0.1007)	(0.0090)
Distance to the main customer (DIS)	0.0683**	0.1341***	0.1133***	0.1501***	0.0158	0.0659	0.0671**
	(0.0286)	(0.0516)	(0.0169)	(0.0378)	(0.0152)	(0.1083)	(0.0302)
Informal payment (IP)							
Political network (PON)	0.0051***	0.0443***	0.0030**	0.0092***	-0.0000	0.0157***	0.0012
	(0.0012)	(0.0109)	(0.0014)	(0.0027)	(0.0007)	(0.0051)	(0.0011)
Law awareness (AW)	0.0506***	0.0480	0.0484***	0.0888***	0.0307***		
	(0.0136)	(0.0675)	(0.0164)	(0.0139)	(0.0100)		
Size (SZ)	0.0007***	0.0017***	0.0008***	0.0008***	0.0015***	0.0015**	0.0006***
	(0.0001)	(0.0005)	(0.0001)	(0.0001)	(0.0002)	(0.0008)	(0.0001)
Household business (HH)	-0.2025***		-0.1807***	-0.2318***	-0.0940***	-0.2370***	-0.2031***
	(0.0198)		(0.0212)	(0.0087)	(0.0280)	(0.0255)	(0.0192)
Urban location (UR)	0.0232	0.2443***	0.0158	0.0299**	0.0001	0.1002***	0.0110
	(0.0179)	(0.0693)	(0.0192)	(0.0123)	(0.0148)	(0.0301)	(0.0157)
Industrial zone (IZ)	0.0240***	0.0921	0.0288***	0.0149	0.0531	-0.0448	0.0381***
	(0.0076)	(0.1017)	(0.0062)	(0.0321)	(0.0462)	(0.0689)	(0.0114)
SECTOR DUMMIES	YES	YES	YES	YES	YES	YES	YES
Observations	2,610	185	2,425	1,125	1,485	440	2,170
Log likelihood	-730.5	-104.0	-620.1	-483.2	-213.1	-217.9	-499.1
Pseudo R^2	0.290	0.184	0.261	0.212	0.351	0.211	0.274

Standard errors in parentheses, adjusted for 5 clusters by firm types
Significance codes: p. < 0.01 '***' p. < 0.05 '**' p. < 0.1 '*'

CHAPTER 5: GENERAL CONCLUSIONS

To sum up, this dissertation has achieved its research objectives with the results of the three empirical studies presented in Chapter 2, Chapter 3 and Chapter 4. The first two chapters confirm the robustness of the controversial EKC hypothesis in various models and samples, which is the first objective 1 mentioned in the Introduction. The second and third objectives are jointly accomplished by the three main chapters. First, Chapter 2 emphasizes the need for considering the country-of-origin factor of FDI. Second, Chapter 3 focuses on the interactive relationship between FDI and institutional variables. Third, Chapter 4 provides an example of the complexity in the trade - governance quality – environmental control nexus with the case of ESCs, export, and corruption in the Vietnamese SME sector. Chapter 4 also features the last objective, which is to gain insights into small-and-medium firms' behaviours regarding their environmental compliance and internationalization orientation in a weak institutional context. The key findings are highlighted as follows:

In Chapter 2, "An empirical investigation of the Environmental Kuznets Curve (EKC) from an international economics perspective: trade, FDI and the origin factor of FDI", the EKC's existence is verified in the panel of 51 developed and developing countries and the subpanel of 23 developing economies. Furthermore, the country-of-origin factor of FDI, which is largely ignored in the literature, is proved to be important to understand the impact of international investment on the environment. FDI from developed countries shows a robust halo effect which reduces carbon dioxide emissions

through technology transfer and development. Whereas, developing country FDI and trade openness are associated with more polluting economic activities.

In Chapter 3, "Interaction between FDI and domestic factors in terms of their environmental impacts in developing countries", all six elements of government indicators are tested while controlling their interaction terms with the two types of FDI, which originate from developed and developing regions. There are two important findings. First, FDI is proven to be an important channel to deliver the environmental effects of institutional qualities. Second, the FDI origin factor is critical to the nature of this interactive connection. FDI from developed economies is less affected by sociopolitical factors of a host country, while FDI from developing regions reacts differently in different domestic contexts.

Last, Chapter 4, "Export propensity, informal payment, politician ties, and the Environment Standard Certificates (ESCs) of Vietnamese SMEs", provides convincing evidence of how export and corruption affect firms' attitudes toward environmental protection. Export encourages SMEs to obtain ESCs because the certification benefited their international market access. However, as SMEs were more likely to obtain ESCs when they paid informal payments and had connections with public servants, obliged environmental control instruments in Vietnam may not reflect the real commitment of environmental protection.

On the whole, this dissertation underlines the challenges and opportunities borne by FDI, trade and institutional qualities for governments and businesses worldwide in general, and in developing countries in particular. The work highlights the importance of institutional reform in the pursuit of sustainable development in the developing

world, especially when most emerging countries are prioritizing FDI-led strategy to fuel their rapid economic growth. If policymakers make a genuine commitment to the environment in their economic agendas, as well as focus on improving governance qualities and a higher law awareness accordingly, FDI can promote greener technology spillovers, and trade can induce better pollution control compliance. Otherwise, their countries will be trapped in the vicious circle of unsustainability. Moreover, more international collaborative effort is required to limit the externalization of environmental costs caused by FDI and trade in weak institutional settings. Besides, businesses should realize the long-term benefits of sustainable practices when embracing internationalization.

The findings of the dissertation elaborate the notion of sustainability in the context of globalization. The original definition of sustainable development has two key concepts: the "needs" of the present and future generations, and the "limitations" imposed by the technology level and social constitution on the ecological capacity of our planet (Brundtland 1987). In the globalization era, when market forces greatly connect economies and drive firms behaviours, the role of environmental leadership at both national and international levels has become an essential element of the sustainable development path. As Chapter 3 and Chapter 4 proved that the root cause of effective environmental management lies in institutional qualities, governments need a strong commitment to embrace sustainability in their development agenda and to work hand in hand to combat climate change. At the time this dissertation is written, the devastating Amazon rainforest fires and Australian bush fires are alarming us of how fragile the ecosystem of our only planet is. It is time for politicians to give up ambitious growth

targets to focus on the quality of development. Although the dissertation cannot answer whether or not all countries can collaborate to save the environment before it is too late, the author preserves the hope that policymakers can have the same vision to commit themselves to improve the environment in their countries and work together to reduce emissions. When the mindset is correct, FDI can spread green technologies and trade can encourage environmental management practices.

The research has some limitations. First, this dissertation does not attempt to introduce a better model to understand the country-of-origin factor of FDI and its interaction with institutional qualities in the developed world. Second, the reasons behind the difference between FDI from developed countries and FDI from developing countries cannot be fully explained within the scope of this work. FDI origin factor may be the proxy for the investment portfolio, culture, CSR, technology know-how, financial capacity, and management experience, etc. of each group. Although Chapter 4 has provided an example, more firm-level studies could be conducted in the future to confirm the key findings of the dissertation. Another interesting suggestion for further studies is that deeper policy analysis can be performed if data related to policy instruments are collected.

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