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**LOCATION DECISION OF FOREIGN DIRECT INVESTMENT:
THE ROLE OF ENVIRONMENTAL POLICY AND NATURAL RESOURCES**

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24 June 2011

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LOCATION DECISION OF FOREIGN DIRECT INVESTMENT:

THE ROLE OF ENVIRONMENTAL POLICY AND NATURAL RESOURCES

K. PUZON

ABSTRACT

This paper examines whether lax environmental policy and abundant natural resources both attract foreign direct investment (FDI). At first, their potential effects are discussed using arguments from the pollution haven hypothesis and the natural resource curse. Using cross-country Ordinary Least Square (OLS) regressions and robustness checks like Instrumental Variable Two-Stage Least Squares (IV-2SLS), it was observed that foreign firms prefer to locate in countries that are resource-abundant or resource export-dependent. Inward FDI also tend to be directed toward countries with relatively stricter environmental regulations.

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Table of Contents	page
Abstract	2
Acknowledgements	3
List of Figures and Tables	7
I. Introduction	8
A. Background	8
B. Objectives	9
C. Scope and Limitations	10
D. Structure of the Paper	10
II. Selected Determinants of Foreign Direct Investment	13
A. Types of Foreign Direct Investment	13
B. The Pollution Haven Hypothesis	14
1. Theoretical Concepts	14
i. Environmental Policy as a Comparative Advantage	14
ii. Strategic Interaction between Governments and Multinational Firms	15
a. Endogenous Firm Location	15
b. Endogenous Environmental Policy	16
2. Empirical Evidence	20
C. The Political Economy of FDI Inflows	23
III. Natural Resources and Economic Development	27
A. The Resource Curse as a Paradox	27
1. Crowding out Effects	27

2. Politico-institutional and Social Conflict Factors	29
i. Institutional Quality	29
ii. Civil Conflict	31
B. The Curse as a Red Herring: Issue of Abundance versus Dependence	32
IV. The Emerging Role of Natural Resources in FDI Decisions	35
V. Revisiting Firm Location Choice: Do Lax Environmental Regulations and Abundant Natural Resources Both Attract FDI?	38
VI. Econometric Models and Regressions Results	41
A. Estimation Approach and Data Sources	41
1. Empirical Strategy	41
2. Description of Data	42
i. Dependent Variable	42
ii. Main Independent Variables	42
a. Environmental Stringency	42
b. Natural Resources	43
iii. Other Independent Variables	45
B. Ordinary Least Squares Regressions	46
1. Benchmark Results	46
2. Summary of Preliminary Analysis	50
C. OLS with Interaction Terms	51
D. Alternative Estimations	54
1. Using Sulfur Emissions as Alternative Environmental Stringency Proxy	54

2. Focusing on Point-Source Mineral Resources	56
3. Instrumental Variable Two-Stage Least Squares Estimation	57
4. Controlling for Potential Outliers	59
5. Instrumental Variable Three-Stage Least Squares Estimation	60
VII. Concluding Remarks	63
A. Summary	63
B. Potential Extensions	63
References	65
Appendix A: List of Countries	70
Appendix B: Descriptive Statistics	71

List of Figures and Tables page

Figures

Figure 1: Correlation between Resource Abundance and FDI. 44

Figure 2: Correlation between Resource Dependence and FDI. 45

Tables

Table 1: List of Theoretical Papers on the Environmental Stringency-Foreign Firm Relocation Relationship. 19

Table 2: List of Selected FDI-related Empirical Studies on the Pollution Haven Hypothesis. 22

Table 3: Empirical Findings on Institutional Quality as a Determinant of FDI. 26

Table 4: Several Relevant Papers on the Resource Curse. 33

Table 5: Few Empirical Papers on the Impact of Natural Resources on FDI. 37

Table 6: Benchmark OLS regressions exhibiting the determinants of FDI. 48

Table 7: OLS regressions with interaction terms. 52

Table 8: OLS regressions with sulfur emissions as environmental policy proxy. 54

Table 9: OLS regressions focusing on point-source mineral resource measures. 56

Table 10: IV-2SLS regressions exhibiting the determinants of FDI. 58

Table 11: IV-2SLS regressions controlling for potential outliers. 59

Table 12: IV-3SLS accounting for the endogeneity of resource dependence. 61

I. Introduction

A. Background

International capital flows, primarily in the form of foreign direct investment (FDI), are generally considered a driving force in the integration of developing economies in the globalization process. Hence, FDI is well-regarded as a possible growth-inducing measure. Such might be reflected by the amount of worldwide FDI. According to the World Investment Report, global FDI inflows increased by 37% to \$1.2 trillion in 2010. Furthermore, although FDI is mostly concentrated in developed countries, the net FDI inflows to developing economies grew at an estimated annual rate of 20 percent from 2000-2008. In addition, it has been noted that transition and developing countries have received almost half of the FDI inflows in 2009.

Usual determinants of FDI include location-specific advantages in terms of market size, labor costs, and openness to trade. More specifically, the motives for FDI can be classified into three types: 1. market-seeking, 2. efficiency-seeking, and 3. resource-seeking (Nunnenkamp and Spatz, 2004). Market-seeking FDI can provide benefits to domestic consumers by introducing new production and increasing competition in host countries. On the other hand, efficiency-seeking FDI, like those in manufacturing, relies on relative factor endowments of domestic economies and economies of scale. Accordingly, it is the FDI type that may bring new technology and enable local firms to benefit from technological spillovers. Lastly, resource-seeking FDI into the primary commodities sector involves huge capital transfers and setup costs, and high foreign exchange earnings.

Furthermore, besides market expansion, FDI may also be induced by cost reduction motives. For example, it is possible that most FDI inflows to developing countries might only be due to their attractively lax environmental policies. Hence, the location decision of trade flows can be explained by the so-called "pollution haven hypothesis". Due to trade liberalization, pollution-intensive industries may tend to transfer to countries with relatively less strict environmental policies (Copeland and Taylor, 2003). On the other hand, natural resources can also be considered a potential

source of income for developing countries. Foreign investment in the natural resources sector may occur when firms invest abroad to acquire cheaper resource inputs (e.g. mineral fuels). However, the role of natural resource wealth in economic development has been put into question by Sachs and Warner (1995). Using cross-country regressions and employing different measures of resource endowment (e.g. the share of natural exports in GDP, the proportion of mining production in GDP, land area, etc.), they found out a negative relationship between natural resource wealth and growth. This observation has been labeled as the “natural resource curse”.

B. Objectives

Indeed, the pollution haven hypothesis has been widely used as an explanation for the location decision of foreign firms. However, factors like natural resource endowment have been rarely taken into account in FDI literature (see van der Ploeg and Poelhekke (2010) for a recent example). Moreover, existing pollution haven hypothesis studies generally fail to take into account factor endowments like natural resources. Focusing on the location decision of foreign firms, this paper’s primary objective is to answer the following: *Do lax environmental regulation and abundant natural resources attract FDI?*

To help answer this question, the similarities and differences of environmental policy and natural resources’ relevance in trade issues may need to be enumerated. Consider first the similarities. First, FDI to countries with less strict environmental policies and abundant natural resources might be due to firms desire to reduce production costs. Second, their effects on foreign firm location choice might be dependent on the existence of decent institutions. Weak institutions may impose additional costs (i.e. in the form of bribes) for pollution-intensive industries. Meanwhile, investors may avoid resource-rich countries with low-quality institutions and open access problems.

Consider now their differences. First, compared to pollution, natural resources are subject to biological processes which may allow them to be replenished over time. Thus, the management of natural resources is an intertemporal issue. Hence, the static

models commonly used in trade and environment analysis (e.g. like those in the pollution haven hypothesis) may fail to take into account the dynamics (Fischer, 2010). Second, compared to relatively mobile, polluting industries, the mobility of resource-exporting firms is rather limited.

To analyze the effects of these two contrasting factors (environmental policy and natural resources) on trade flows and firm location decisions, FDI is used as dependent variable. The use of FDI is in comparison to most pollution haven hypothesis studies which use import and export measures. Emphasis is given on FDI as it has been of growing importance in the economy of developing countries (*see first paragraph of introduction again for more details*). In addition, a narrower or more specific focus on FDI is done because it is a measure reflecting the preference of foreign investors on a given country's economic prospects. Most of all, the use of FDI may avoid complex problems associated with measuring economic success with GDP. It might be better to start at a "source" of economic growth (FDI) first.

C. Scope and Limitations

The empirical analysis covers 40 developed and developing countries. Due to the limited availability of long-run time series data for all variables, cross-country regressions are conducted. Various measures for environmental stringency (Environmental Performance Index and sulfur dioxide emissions) and resource wealth (export dependence and natural capital) are also employed. Finally, macroeconomic datasets instead of firm-specific data are used.

D. Structure of the Paper

Again, this paper investigates whether FDI location decisions can be affected by both controllable (environmental policy) and uncontrollable (resource endowment) factors. In a preliminary attempt to answer this question, this paper is organized using a step-by-step approach.

Focusing on the pollution haven hypothesis, Part II discusses the selected determinants of FDI inflows. Emphasis is given on the impact of environmental stringency and institutional quality on FDI location choice. Part III then provides a survey of literature on the natural resource curse. Two channels are analyzed: 1. the macroeconomic perspective through the crowding out effects of resource wealth, and 2. the sociopolitical and other institutional factors that might be related to the resource curse. Part IV, on the other hand, provides a quick look at a very few FDI-related studies with natural resources as a control variable. While these papers do not study the pollution haven hypothesis, they provide a strong basis on the ability of natural resource endowment to attract FDI inflows.

Using the survey of literature from Parts II to IV, Part V then argues for the importance and potential contributions of this study. It discusses the possible impact of environmental stringency and natural resource wealth on FDI location decisions. A detailed comparison of both factors is done. For example, several differences like their mobility (one controllable and one uncontrollable factor) are discussed. Their possible similar impacts on FDI location decision has also been thoroughly taken into account. For instance, Part V argues that lax environmental policies and natural resource access may attract foreign investors who want to reduce costs.

Part VI then provides an intensive econometric investigation. Unlike previous FDI location decision studies, this paper contributes to economic literature by using different resource wealth measures. The possible difference between the effects of resource export *dependence* (the usual resource curse variable) and natural capital *abundance* (using relatively new resource stock datasets) are distinguished. This distinction is employed because resource-rich countries that have also developed other industries may not necessarily be dependent on primary exports. At first, Ordinary Least Squares (OLS) regressions are conducted. After presenting the baseline OLS regressions, this study then investigates the interaction effects of natural resources and institutional quality. This is done to support the argument that the resource curse might only be due to bad institutions interacting with resource wealth, rather than resource export dependence *per se*. Robustness checks like Instrumental Variable-Two Stage Least

Squares (IV-2SLS) estimations are employed as well. Estimations like those controlling for possible outliers and accounting for alternative resource wealth and environmental stringency proxies are also utilized. In the end, it was consistently observed that both the pollution haven hypothesis and natural resource curse do not hold in the context of FDI inflows. FDI appears to be more attracted toward countries with abundant natural capital or high dependence on resource exports, and where environmental regulation is relatively stricter. Finally, Part VII concludes.

II. Selected Determinants of Foreign Direct Investment

A. Types of Foreign Direct Investment

According to United Nations Conference on Trade and Development (2002), foreign direct investment or FDI “refers to an investment made to acquire lasting interest in enterprises operating outside of the economy of the investor”. In other words, it can be defined as an investment in which a multinational firm sets up a subsidiary in a foreign country.

Because FDI contributes to capital accumulation, it obviously may promote economic development. Not only does FDI have this direct effect, it has been noted that FDI may induce positive externalities that result to economic growth. For instance, FDI may permit productivity increase by allowing the transfer of technology and knowledge from one country to another (De Gregorio, 2003). Other spillovers include employment creation and management know-how that may also increase domestic firms’ productivity (Lipsey, 2002).

Given the potential importance of FDI for economic growth, let us analyze the determinants of FDI. According to the Kinoshita and Campos (2002), FDI can be categorized into three types. First, market-seeking investment is undertaken to expand the market share of a multinational firm. Because the motive for this type of investment is to serve a local market by local production, the market size and market growth of the host economy are the major determinants that encourage market-seeking FDI. Second, when firms invest abroad to acquire resources not available in the home country, the investment is called resource-seeking. Resources may be natural resources, other raw materials, or even low-cost labor. Unlike market-seeking FDI, this type of FDI does not only serve the local market. Outputs from this type of investment are also sold to both the home-country and third-country markets. Availability of raw materials, and cheap (and/or skilled) labor are two of the main determinants of resource-seeking FDI. Third, the FDI is efficiency-seeking when the firm can gain from economies of scale and scope. For this type of FDI, an institutional environment conducive to the establishment of corporate networks is necessary (Kinoshita and Campos, 2002).

B. The Pollution Haven Hypothesis

Besides the usual FDI determinants, environmental stringency has been recently considered as an important factor in inducing foreign firm relocation. In this section, environmental regulation as a factor in determining FDI location decisions is discussed.

1. Theoretical Concepts

i. Environmental Policy as a Comparative Advantage

Again, because of the reasons put forth above, the conditions attracting FDI inflows has been of interest in economic literature. Of particular interest is the ability of lax environmental policies to attract international capital inflows to developing countries. Related to this is the concept of “pollution havens”.

The pollution haven hypothesis predicts that “the dirtiest industries should locate in countries with weak environmental regulations” (Copeland and Taylor, 2003, pg. 187). With lower pollution abatement costs brought by lax environmental standards, foreign firms may enjoy lower total production costs and thus, relocate. Indeed, this pollution haven effect is corollary to the theory of comparative advantage. The countries specialize and take advantage of their relatively abundant factor endowment to gain competitiveness in the international economy. The difference in specialization that leads to trade might be due to the income effect. With higher incomes, developed countries may tend to demand cleaner environments instead. On the other hand, in developing countries, the possibility of higher incomes brought by investments are more valued. Because of the differentials in environmental regulations and the comparative advantage of developing countries in the production of pollution-intensive commodities, foreign firms are attracted to lax regulations and lower pollution abatement costs in these “havens” (Copeland and Taylor, 2003). Furthermore, the existence of pollution havens can be distinguished by two effects: “volume effect” and “composition effect”. For instance, a negative (or positive) volume effect captures the fact that a stronger environmental regulation in a host country tends to discourage (or encourage) inward FDI. On the other hand, a negative (or positive) composition effect implies that more (or

less) pollution-intensive FDI would go to a host country with relatively weaker environmental standards (Javoricik and Wei, 2004).

ii. Strategic Interaction between Governments and Multinational Firms

Related to the explanation of the environmental stringency-firm relocation relationship is the strategic interaction between the government and multinational firms. In this regard, game theoretic models studying this relationship are discussed. In the first stage, the government decides on the environmental policy. In the next stage, firms choose where to locate production.

a. Endogenous Firm Location

In the first set of theoretical papers, only the location decision of firms is endogenized. The impact of environmental policy on the location decision of multinational firms is investigated. Related to this is the early work by Markusen, et al. (1993) which, as implied, considers production plant location as a function of environmental policy. That is, stricter environmental regulation may cause firms to relocate their production plants. It is a single-shot Cournot game which is characterized by a two-country, two-firm model with pollution. Herein, they assume increasing returns to scale, transportation costs, and imperfect competition between the domestic and foreign firm. There are two stages in the game. First, after observing the exogenous environmental policy of both governments, the firms make a strategic decision on plant location: no entry, one plant location only, or two plants in the domestic and foreign markets. The second stage is characterized by a Cournot output game. The pollution haven element is the case wherein the firm decides to put all production abroad. In this case, the possible existence of a pollution haven is investigated by allowing only one government to impose stricter environmental regulation, e.g. whether in the form of a pollution tax or increased marginal costs due to abatement. Finally, the authors concluded that, at critical levels of environmental stringency, policy changes causes large jumps in a given country's welfare as a firm changes its location option (i.e. decide to stay in the domestic country or move operations abroad).

Following the same logic as above, Motta and Thisse (1994) continued to analyze under which conditions environmental policies lead firms to relocate production activities. They assumed that only one firm chooses location and only one government decides on environmental standards, which introduces higher variable costs. In striking contrast with Markusen, et al. (1993), in the first stage of the game, firms have sunk or fixed costs in the domestic market. Motta and Thisse (1994) obtained a different result with large sunk costs. Even with increased costs given by stricter environmental regulation in the domestic country, delocation abroad might not be the optimal decision. The domestic firm will only decide to relocate abroad if it has incurred loss in international competitiveness (due to the higher costs imposed by environmental stringency) and if it has a small sunk cost.

Finally, the papers above were then extended by Markusen, et al. (1997). Now, both the two governments impose environmental policy standards. Using an oligopoly model, multinational firms can be located in both domestic and foreign countries. Compared to the first model discussed above, they noted that multinational firms may not necessarily make location decisions responsive to increased costs. Instead, firms may smooth the effects of cost increases (e.g. like those caused by more stringent environmental policies) in one country over possibly two plants separately located in the two different countries. Welfare effects are dependent on cost types. When the environmental regulation-induced cost increase affects plant-level fixed costs, welfare and output effects are not severe. In this case, these effects are absorbed by the exit of some firms. On the other hand, if the regulation-induced cost affects variable costs, welfare was found to be adversely affected. That is, welfare decreases substantially.

b. Endogenous Environmental Policy

Note that none of the previously mentioned theoretical studies of the foreign direct investment-environmental stringency relationship consider strategic environmental policies. All of the previous studies only consider firm location choices endogenous. Hence, some tried to fill this gap by analyzing strategic environmental

policies in the presence of FDI. In other words, environmental stringency is now considered endogenous.

For instance, Hoel (1997) assumed that both firm location and environmental policy are endogenous. In his partial equilibrium model, the first stage involves the governments deciding on the stringency of their environmental policies, e.g. tax rates. In the second stage, firms strategically decide on the location of production activities. In contrast to other papers, for his study, Hoel (1997) had a zero transportation costs game between the governments of the two countries. Negative environmental externality from production is also assumed. With these assumptions, it is not clear as to whether environmental protection is less or more strict under non-cooperation than in the case where governments coordinate policies. When the disutility from pollution is high enough, each country might prefer production to locate abroad only. On the other hand, if a given domestic economy may want to increase industry share by lowering production costs, it may decide to choose lower environmental standard. Therefore, environmental policy under non-cooperation can be more lax.

Kayalica and Lahiri (2005) also assumed the endogeneity environmental regulation. More specifically, they investigated strategic environmental policies in the presence of FDI. The oligopolistic framework involves a number of foreign firms located in the host country. There their production competes with those from a domestic firm in another country. Compared to previous models, they compete to export a homogenous good to a third country. Also note that the government of the second country does not allow any FDI. In the non-cooperative solution, the absence of foreign firms causes the domestic country to apply higher emission standards than the other countries. When the number and location of foreign firms remains exogenous, pollution remains the only concern of the government. These results will differ once there is free entry and exit in the FDI market. When governments act non-cooperatively, the FDI host country will impose more stringent pollution restrictions than the other country only under certain conditions. More specifically, it only happens when the reservation profits of the firms (i.e. the minimum profit foreign firms require to enter the FDI market) are small enough

and if the marginal disutility of pollution is sufficiently small. Unlike the first case of no-entry, the government will try to attract FDI by relaxing environmental standards.

All of the previously discussed studies have assumed perfect information among all agents. To put it differently, Celik and Orbay (2011) analyzed how a developing country can strategically use trade and environmental policies to control pollution and attract FDI when there is uncertainty about the damage caused by the foreign firm's production. The first stage involves a (domestic) developing country setting a pollution tax and import tariff. The authors then assumed that there exists information uncertainty about the environmental damage that the foreign firm may impose on the developing country. It is also assumed that the domestic firm is less efficient than the foreign firm. In the second stage, having complete information on its damage, the foreign firm from a developed country decides where to locate. In the third stage, the usual Cournot game is played. The authors found out that the developing country can be better off in attracting FDI if the marginal damage of pollution is sufficiently low. In contrast, if the marginal damage of pollution is high, then the developing country should choose a pollution tax which can deter FDI inflows and motivate the developed country to just export from its home grounds instead.

Finally, maintaining the endogenous nature of environmental policy, Cole and Fredriksson (2009) extended theoretical literature by exploring the impact of political institutions. In a multi-principal, multi-agent political economy model, they also assumed a reversed causality: FDI inflows affect environmental stringency measures. Compared to the previously mentioned studies, however, they assumed that foreign firms may lobby and bribe the host country's government. They do this in the first stage in order to influence the second stage: the environmental policy making of the domestic government's legislative units. It is assumed that both the domestic and foreign firms form this lobby group. Also, the legislative units are noted to have an aggregate honesty level which reflects their tendency to avoid corruption. As in the previous theoretical models, as exhibited in the third stage, there is Cournot competition in the domestic market. In the end, the authors predicted that the relocation of firms (signaled by increased FDI inflows) has two major, probably contrasting effects. The first one states

that FDI inflows weaken the power of governments to impose stricter environmental tax standards. This is because additional multinational firms increases lobbying. On the other hand, greater competition induced by FDI inflows may allow the local government to increase the pollution tax. The intuition is that in an imperfectly competitive market with polluting firms, a welfare maximizing government sets a second-best tax policy which addresses both the pollution damage and the insufficient level of firm competition. With more market competition due to FDI, the government's tax becomes stricter since the government's incentive to lower this tax decreases. Consequently, the result will depend on which of these two effects is larger. In conclusion, they stated that greater environmental stringency is only observed when the number of government legislative units and their aggregate honesty are high enough.

In summary, the theoretical papers above have discussed the complex relationship between environmental stringency and foreign firm location choice. It has been seen that the firm location will differ on whether or not environmental regulation is considered exogenous or endogenous (Table 1). As explicitly detailed above, the results depend on the assumptions made: the existence of sunk costs, the consideration of asymmetric information, and even the inclusion of political factors.

Table 1: *List of Theoretical Papers on the Environmental Stringency-Foreign Firm Relocation Relationship.*

Study	Primary Assumptions	Results
Endogeneous Firm Location Only		
Markusen, et al (1993)	-One government imposes stricter environmental policy through a pollution tax or higher abatement costs	-Critical levels of environmental stringency helps a foreign firm decide on whether to operate domestically or abroad
Motta and Thisse (1994)	-Existence of fixed costs in the domestic market	-Firm relocation abroad might not be optimal when there are large sunk costs
Markusen, et al (1997)	-Both the two governments simultaneously impose environmental policy	-If regulation-induced costs are variable, welfare losses can be high
Endogenous Firm Location and Endogenous Environmental		

Policy		
Hoel (1997)	-Zero transportation costs -Negative environmental externality from production	-When the disutility from pollution is sufficiently high, firms might locate abroad only
Kayalica and Lahiri (2005)	-Main emphasis on FDI -Existence of a third country -Reservation profits of foreign firms	-If reservation profits of foreign firms are large, the government will try to attract FDI by relaxing environmental policies
Cole and Fredriksson (2009)	-Foreign firms may lobby and bribe the host country	-FDI weakens the power of governments to impose environmental policies, but greater competition induces government to increase pollution taxes
Celik and Orbay (2011)	-FDI from a developed country into a developing country -Asymmetric information in the environmental damage of the foreign firm	-When the expected marginal damage of pollution is sufficiently high, FDI inflows may not be beneficial to the host country

2. Empirical Evidence

This section contrasts several empirical papers supporting and debunking the pollution haven hypothesis. One notable paper supporting the existence of pollution havens is the one by Xing and Kolstad (2002) investigating the association between sulfur emissions in a host country and FDI from five US industrial sectors. They found out that the pollution haven hypothesis might only be applicable to certain industries and not for others. For example, there is a negative linear relationship between FDI of the US chemical industry and the stringency of environmental regulation in a foreign host country. They were unable to find a similar effect for other sectors for which pollution is less of a problem, e.g. electrical and non-electrical machinery. Despite using a robust estimation procedure using simultaneous equations, the robustness of their study is debatable as the sample size (22 host countries) is rather small. Meanwhile, using inward United States FDI data, List and Co (2000) estimated the effects of state environmental regulations on foreign multinational corporations' new plant location decisions from 1986 to 1993. Using state-level and firm-level pollution abatement

operating expenditures from the PACE (Pollution Abatement Costs and Expenditures) dataset, they noted that less strict state environmental regulations attract more FDI inflows. More recently, Dean, et al (2009) estimated conditional logit and nested logit models using new data sets containing information on a sample of joint venture projects in China, environmental levies on water pollution, and industry estimates of Chinese pollution-intensity. They noted that environmental stringency does affect the location choice of foreign investment. Low environmental levies are a significantly attractive feature for joint ventures in highly-polluting industries with partners from Taiwan, Hong Kong, and Macao. In contrast, OECD sources are not attracted by lax environmental regulation, regardless of the pollution intensity of the industry.

However, some empirical literature on pollution havens failed to detect significant association between the environmental protection standards of host countries and FDI (Zarsky, 1999). In fact, Levinson (2010) has recently noted that the composition of U.S. imports shifted towards relatively clean goods, rather than polluting goods. He observed this shift from 1972 to 2001. This finding is supported by using the World Bank's 1987 inventory of industry-specific U.S. air pollution emissions intensities, input-output tables, and data on U.S. imports. Another example is the early findings of Levinson (1996) wherein he surveyed econometric papers investigating the association of environmental regulation and foreign investment relocation in the United States. He concluded that the pollution haven hypothesis generally failed to materialize. This is further supported by Javoricik and Wei (2004). They used a firm-level dataset on US investment projects in 24 transition economies for 1989 to 2004. Using different environmental stringency measures, they also found some support for the "pollution haven" hypothesis. However, the overall evidence is relatively weak and does not survive robustness checks.

Table 2 summarizes pollution haven hypothesis papers specifically focused on foreign direct investment. The failure to find empirical for pollution havens might be due to aggregated datasets. This suggests the usefulness of employing a firm-level data set (Javoricik and Wei, 2004). Inconclusive research might also be due to the fact that it is difficult to measure the varying strength of environmental protection in different host countries. Different environmental stringency proxy measures (e.g. sulfur and carbon

measure, pollution abatement expenditures, number of environmental treaties signed) may also lead to contrasting findings (Aliyu, 2005). In most empirical studies, there is no *direct* measure of the strictness of regulations and the policy discussion is primarily descriptive (Xing and Kolstad, 2002).

Table 2: List of Selected FDI-related Empirical Studies on the Pollution Haven Hypothesis.

Study	Scope	Environmental Regulation Proxy	Summary of Results
Xing and Kolstad (2002)	-inward FDI from the US to 22 host countries -FDI from 5 specific industrial sectors in the US	-Environmental performance through sulfur dioxide emission measures	-Significant effect, but only for certain industries (chemical industry) -No effect for other sectors
List and Co (2000)	-1986 to 1993 data -new foreign plants in the USA	-PACE (firm-level pollution expenditures) -State-level environmental performance measures	-Significant effect -Lower environmental stringency, higher probability that a foreign firm will locate in a given state
Javoricik and Wei (2004)	-Firm-level FDI to 24 transition economies -1989 to 2004 dataset	-Environmental performance -External evaluation of one NGO -Participation in international treaties	-After robustness checks, no significant effect
Dean, et al (2009)	-1993 to 1996 joint venture projects with foreign firms in China	-Levies on water pollution	-Significant effect, but only for investments from some East Asia partners like Taiwan -No pollution haven effect on OECD FDI sources

Literature offers others explanations for the conflicting empirical support for the existence of pollution havens. Other reasons have been summarized by Levinson and Taylor (2006). Accordingly, they noted that pollution havens may fail to exist as it is possible that pollution abatement costs only represent a small share of the costs. Hence, stricter environmental standards may not necessarily affect firms' total costs and

international competitiveness. Another explanation utilizes the Porter hypothesis. It was stated that more stringent regulation may induce cost-reducing innovation. Hence, firms may not necessarily experience higher costs and relocate.

Finally, endogeneity issues may also be exhibited by the FDI-environmental stringency nexus. In other words, in the long-run, environmental stringency's exogeneity might be in doubt. Policymakers may then consider the effect of FDI on environmental laws. Greater production provided by inward FDI may lead to greater income. This increase in incomes may later induce higher demand for environmental quality. Hence, in the long term, environmental stringency may then become a function of FDI.

C. The Political Economy of FDI Inflows

The structure of political institutions may affect the environmental stringency-firm location relationship. Indeed, the quality of political institutions seems to be another integral determinant of international capital inflows. It is highly possible that the omission of the institutions variable may affect the econometric results on pollution haven studies. That is, there might be an omitted variable bias problem in existing FDI-related pollution haven hypothesis literature. Therefore, this section summarizes empirical studies related to the political economy of FDI. Except for Javorcik and Wei (2004), due to the lack of relevant published papers, these recent studies are *not directly* related to the environmental stringency-FDI relationship discussed previously. However, note that the inclusion of these studies is still relevant as they show that institutional quality matters in the FDI location decision process.

The first strand of literature revolves around the effect of corruption on FDI inflows. A primary example for this is the paper by Javorcik and Wei (2004). They stated that a developing country's weakness in institutions may deter FDI flows. For instance, corruption, in the form of bribes to government officials to get favors like investment protection, might be considered an additional investment cost. Consequently, if a country is characterized by environmental laxity but corruption, it may not be as attractive for investment as an economy with slightly higher environmental stringency

but less corruption. In other words, a lower level of corruption might make up for higher environmental standards. Thus, it is possible that pollution havens may not be observed. Existing empirical studies may suffer from the omission of the institution-related (e.g. corruption) variable as there might also be a correlation between environmental policy and institutional quality.

Using corruption perception indices as a control variable, this negative impact of corruption on FDI has also been shown in political economy literature. For example, using 1993 cross-section FDI data, Wei (2000) examined the effect of corruption to FDI. More specifically, he conducted his study using bilateral investment data from 12 source countries to 45 host economies. Indeed, he concluded that the higher level of corruption in a host country significantly reduces FDI outflows going to that country. However, the notion that corruption is costly for FDI has been recently challenged by Egger and Winner (2005). In their paper, they argued that corruption can provide incentives for inward FDI. In the presence of multiple administrative procedures, corruption may serve as a “helping hand” to foster investments. This is because corruption may increase revenues by making the bureaucratic process faster (i.e. by the possible quick approval of the legal permissions for plant setup), and by letting investors have access to publicly funded projects. Using a panel of 73 developed and developing countries for 1995 to 1999, Egger and Winner (2005) have shown that corruption has a positive association on a host country’s attractiveness for FDI inflows. The contradiction between these results with that of Wei (2000) can possibly be explained by the differences in the time frame and the sampling countries investigated. For instance, Wei only used one year (1993) as a sampling point, whereas Egger and Winner used a longer time frame from 1995 to 1999. Egger and Winner’s study is also based on a period when there was a financial crisis in emerging markets. Furthermore, for Wei, the datasets used were more specific. The dependent variable is the stock of bilateral FDI in logarithm in 1993 from source country i to host country j . In this case, not all countries receive direct investment from all source countries. He used a Tobit model to account for this possibility. Meanwhile, even if both studies used Transparency International's corruption index as

explanatory variable, Egger and Winner used total (*not source-specific*) FDI stocks as dependent variable. With this, they conducted fixed effects panel data estimation.

The second strand of studies involves the association between democracy and foreign direct investment. In theoretical grounds, contrasting explanations on the ability of democratic governance to attract FDI have been put forward. For example, O'Donnell (1988) argues that less democratic regimes attract foreign investors more. Because of the ruling political elites' interest in the economic rents from FDI inflow, they attract foreign investors by ensuring less taxation and lower wages. In contrast, Olson (1993) argues that democratic governance better protect property rights. The enforcement of property rights, in turn, may imply a stable economic environment which is conducive for long term foreign investments. Consequently, contrary to O'Donnell, Olson implies that democracy is more attractive to FDI inflows.

The surprisingly few empirical studies on the link between democracy and FDI find conflicting results as well. At one end of the spectrum, with both a cross-section and panel regression of 114 developing and developed countries from 1970 to 1997, Jensen (2003) shows that foreign investors prefer to invest in countries characterized with more democratic institutions. He reasoned out that democracy may signal the credibility of governments in enforcing business contracts. Meanwhile, Li and Resnick (2003) exhibited the opposite of those found by Jensen (2003). Using on OLS regressions and a sample of fifty-three developing countries from 1982 to 1995, they noted that democracy and FDI inflows have a negative correlation. They argued that democracy gives constraint to elected government officials. Thus, the perceived weaker power of these politicians may go together with the reduction in the monopolistic positions of multinational corporations. The differences between the findings by Li and Resnick (2003) and Jensen (2003) can be explained by the fact that their sampling countries are extremely different. Jensen examined FDI inflows for both developing and developed economies. Hence, there might be more heterogeneity in the dataset. On the other hand, Li and Resnick based their investigation on developing countries only. In addition, the source of democracy scores differs for both studies.

In conclusion, the theoretical inconsistencies on the effect of political institutions on FDI location decision have been reflected empirically as well. As summarized in Table 3, contradictions in findings might be due to the differences in the countries investigated, the time frame used, and the econometric method employed.

Table 3: *Empirical Findings on Institutional Quality as a Determinant of FDI.*

Study	Scope	Institutional Quality Measure	Effect on FDI
Javorcik and Wei (2004)	-Corruption as control variable in pollution haven hypothesis and FDI study -Firm-level data on investment project in 24 transition economies	-Composite corruption measure from Global Competitiveness Report and the World Development Report	-Corruption hinders FDI
Wei (2000)	-12 source countries, 45 host economies; 1993 FDI data only	-Transparency International's corruption perception index	-Corruption reduces FDI
Egger and Winner (2005)	-73 developed and developing countries; Panel data from 1995 to 1999	-Transparency International's corruption perception index	-Corruption increases FDI
Jensen (2003)	-114 developed and developing countries; 1970-1997	-Political regime (democratic governance) scores from Polity III	-Democracy increases FDI
Li and Resnick (2003)	-53 developing countries only; 1982 -1995	-Political regime scores from Polity IV	-Democracy decreases FDI inflows

III. Natural Resources and Economic Development

A. The Resource Curse as a Paradox

Meanwhile, natural resource endowment can be another source of potential income for developing countries. A recently popular concept relating natural resources and economic development is the “natural resource curse” or the “paradox of the plenty”. The curse of natural resources, i. e. the observation that countries with larger endowments of natural resources tend to grow less than those which are less endowed, have been recently empirically analyzed. Of prominence in economic literature are the seminal papers by Sachs and Warner (1995; 1999; 2001). Using Ordinary Least Squares (OLS) regression analysis, they explicitly noted that dependence on mineral reserves and oil (measured through dependence on primary commodity exports) is negatively correlated with economic growth rates. Overall, recent studies have implied that there are two possible channels for the curse: 1. Crowding out effects, and 2. Institutional factors.

1. Crowding out Effects

From a macroeconomic perspective, the crowding-out effects of the resource curse is described by the so-called “Dutch Disease”. Traditionally, the Dutch disease happens when an increase in the productivity or a boom in one traded sector of the economy (e.g. the natural resource sector) reduces profitability in another traded goods sector (Corden and Neary, 1982). Strong growth in exports causes the country’s currency experiences appreciation. This “spending effect” makes the other economic sectors less competitive in foreign markets. Moreover, a “resource movement effect” can take place as production shifts into the booming sector. Thus, dependency on the natural resources sector is further intensified. The economy becomes more vulnerable to natural resource price volatilities.

Frankel (2010) aptly summarizes the macroeconomics of the Dutch disease. He stated that the Dutch disease “phenomenon arises when a strong, but perhaps temporary, upward change in the world price of the export commodity causes:

1. a large real appreciation in the currency (taking the form of the nominal currency appreciation if the country has a floating exchange rate or the form of money inflows and inflation if the country has a fixed exchange rate);
2. an increase in spending (especially by the government, which for political economy reasons increases spending in response to the increased availability of tax receipts or royalties);
3. an increase in the price of non-traded goods (goods and services such as housing that are not internationally traded), relative to traded goods (internationally traded goods other than the export commodity), and
4. a current account deficit.”

In relation to the natural resource curse, the Dutch disease channel is again well-explained by Sachs and Warner (1999). Using a modified Dutch disease model and carefully following Matsuyama’s (1992) argument, they pointed out that resource abundance shift resources away from sectors of the economy (e.g. manufactures) that have positive externalities to economic growth. That is, there is dynamic “crowding out”. More specifically, a productivity increase in the primary commodities sector may cause a de-industrialization in other export sectors. If exports of manufactures are an important engine of development, then this de-industrialization provides a channel for the negative correlation between economic growth and natural resource abundance.

Overall, Sachs and Warner (1995; 1999; 2001) imply that natural resource abundance makes export sectors, e.g. manufacturing industry, uncompetitive in the international market. Indeed, this case puts the economy in detriment especially if the tradeable, manufacturing sector experiences increasing returns to scale through learning-by-doing. In other words, the exploitation of natural resources shrinks the traded sector, squeezes learning-by-doing, and therefore reduces productivity growth. As a consequence, a possible export-led growth is hindered. More recently, however, Torvik (2001) that both traded and non-traded sectors can contribute to learning. He

noted that productivity growth may go up if the intensity of learning spillovers between economic sectors is higher than a given threshold.

Lastly, the previously discussed theoretical predictions of the Dutch disease channel for the resource curse have been empirically analyzed as well. Using a cross-section of 52 countries, Sachs and Warner (1995) exhibited that resource-intensive economies had slower growth in manufacturing sectors. Meanwhile, using a gravity model, Stijns (2003) econometrically investigated the effect of natural resource booms on countries' real manufacturing exports. He employed a gravity model that considers the trade flows between two countries as a function of their GDP and distance. In his panel data estimations, he used 1970 to 1997 trade data for a set of developing and developed countries. In conclusion, it was noted that energy booms, together with primary commodity price increases, tends to systematically depress trade in the manufacturing sector.

2. Politico-institutional and Social Conflict Factors

Besides the macroeconomic argument discussed above, literature offers institutional explanations of the natural resource curse. This section discusses institutions as channels for the curse.

i. Institutional Quality

The resource curse can be related to the presence of poor institutions and rent-seeking. Natural resource endowment may hamper economic growth in the presence of weak institutions like autocracy, inefficient legal systems, weak rule of law, and poorly defined property rights (Arezki and van der Ploeg, 2006).

More specifically, the relationship between natural resources and institutions can further be explained by the "Rentier effect". The Rentier effect implies that resource rents let politicians choose non-profit maximizing and rent-seeking activities which hamper growth. To put it more formally, this phenomenon originates from the monetary gains from fuel and mineral exports. These monetary gains then cause governments to

bribe critics, discourage institutional efficiency through red tapes, and increase incentives for corruption through lobbying and cronyism. These monetary gains are mostly relevant for natural resources whose exploitation is concentrated, e.g. oil rather than agriculture. Indeed, natural resource revenues help political elites block both technological and institutional development. In the end, rent-seeking activities help the incumbent government gain control of both political power and resource rents (Acemoglu and Robinson, 2006). In addition, Sala-i-Martin and Subramanian (2003) described that corruption through the granting of import licenses and cronyism rather than the Dutch disease seem to be the reason why oil abundance has ruined the growth performance of some developing countries like Nigeria. This could be contrasted with the seemingly better performance of resource-rich countries with high quality institutions (e.g. Botswana and Norway).

Finally, several authors have also concluded that the strength of the adverse impact of resource dependence depends on the type of resources. In particular, it is more damaging for “point-source” resources---natural resources like oil and minerals which are easily appropriable and are characterized by concentrated production (Isham, et al., 2005). This is contrast to “diffuse” natural resources, e.g. forestry and agricultural produce, whose revenue gains are more dispersed throughout the economy (Auty, 1997). Indeed, the extent of appropriability of the type of natural resource matters.

The above rent-seeking explanations have been investigated by some econometric studies. Similar to FDI determinants, institutional quality variables in these studies utilize measures like corruption perception indices. These empirical papers examine how good state institutions transform the effect of resources on growth. More specifically, most of the recent research studies test the hypothesis that resource abundance deters growth only if a state is characterized with bad institutions, e.g. corrupt governments. For example, Sala-i-Martin and Subramanian (2003) demonstrated that natural resources have a detrimental effect on growth only “indirectly” by their impact on sociopolitical institutions. By including a control variable on institutions in the regressions, resources were noticed to have insignificant effects on growth. Meanwhile, using an institutional quality index (index combining rule of law,

corruption, bureaucracy, expropriation risk, and government contract repudiation), Mehlum, et al. (2006) recently found additional evidence for this. Following Sachs and Warner's cross-sectional estimation method, their sample consists of 87 developed and developing countries. Mehlum, et al. used an institutional quality index. The index is the average of five scores based on data from *Political Risk Services*: a rule of law index, a bureaucratic quality index, a corruption in government index, a risk of expropriation index, and a government repudiation of contracts index. In conclusion, they have presented results which support the hypothesis that good institutions have a neutralizing effect and can turn the natural resource curse into a blessing. Using an interaction effect variable between resource abundance and institutional quality, they find that states with good institutions do not exhibit the curse.

Similar to a few studies on FDI, political risk (in the form of the degree of democracy) is another possible measure of institutional quality. For instance, Persson and Tabellini (2003) implied that the resource curse occurs more often in presidential democracies than those characterized by a parliamentary system. This is also applicable to authoritarian regimes. More specifically, Ross (2001) noted that economic dependence on oil and mineral reserves is correlated with dictatorial ruling. A probable reason for these results is that presidential democracies and authoritarian regimes exhibit less accountability. Consequently, they are often more susceptible to natural resource rent extraction.

ii. Civil Conflict

A related issue to the institutional quality channel is that of civil conflict. The central question is the following: Do natural resource abundance lead to and intensify civil wars? This is because rents from easily appropriable natural capital, like diamonds and oil, may result to conflict. Thus, resource abundance may further intensify domestic wars. The existence of civil conflict may eventually prove to be bad for economic development. Examples for this include the cases of oil-rich countries like Sudan and Angola (Frankel, 2010).

There are some possible explanations on how natural resources may lead to social conflict: 1. Grievance mechanism, and 2. Looting mechanism (Collier and Hoeffler, 2004). The first notes that the extraction of natural resources by other agents induce local people to feel insufficiently compensated for losses due to land expropriation and the like. This feeling of grief later leads to local civil wars. On the other hand, the looting mechanism describes natural resources as sources of money for rebel groups. Rebels gain profit by either directly extracting resources or extorting rent from other agents who do. Hence, in the end, these profits are used to fund rebel groups and increase the probability of civil wars. Finally, another possible explanation is discussed by Caselli (2006). He noted that the resource curse might be induced by power struggles among the elite. If the amount of resource royalties that the ruling elite can appropriate for themselves are reduced, then the negative effects of resource rents (a la resource curse) can be lessened. Accordingly, less appropriability lessens the incentives for potential challengers to stage a rebellion.

Empirically speaking, few research studies like those by Collier and Hoeffler (2004) noted that economies with heavy reliance on primary commodity exports are more likely to experience social conflict compared to countries with less natural resource. However, this seemingly unanimity of natural resource-conflict link is put into question by Brunnschweiler and Bulte (2009). In part of their study, they explored the determinants of resource dependence using a panel dataset of nine 5-year periods. They argued against the causal link from resource export dependence to conflict. Instead, their findings suggest that civil conflict results to dependence on natural resource exports.

B. The Curse as a Red Herring: Issue of Abundance versus Dependence

As exhibited above, the empirical evidence for the natural resource curse may seem a bit ambiguous. Indeed, the resource curse can be argued as a possible red herring (Brunnschweiler and Bulte, 2008). In particular, Brunnschweiler and Bulte (2008) analyzed an alternative measure of resource abundance. They argue that the common export-related variables, e.g. share of oil exports to income, are endogenous

to structural factors. Also, they noted that the usual exports variable is a proxy of “resource dependence”. In addition, they implied that resource dependence itself may have an effect on the institutional quality variables in the traditional resource curse variable. Thus, using total natural capital per capita as an alternative measure, they have shown a positive association between “resource abundance” and economic growth. Using two-stage least squares (2SLS) and three-stage least squares (3SLS) regression analyses, they instrumented natural resource dependence by subsoil assets (resource abundance measure), and by institutional and constitutional variables. Contrary to the traditional resource curse, they found out that natural resource exports have no significant impact on growth. They even found out that greater resource abundance causes higher growth rates. Compared to previous findings that resource “dependence” hinders growth, they concluded that natural resource “abundance” might actually be growth-inducing.

Overall, it can be synthesized that the existence of the natural resource curse depends on different factors (see Table 4 for a summary of the most relevant papers discussed in this section). Theoretical results depend on assumptions on the possibility of learning spillovers and even on the existence of power struggles among elites. In the empirical side, it has been seen that good-quality institutions can prevent the curse. The empirical relevance of the curse is also questioned by the way resources are measured, be it resource dependence or their abundance.

Table 4: *Several Relevant Papers on the Resource Curse.*

Study	Primary Assumptions or Scope	Summary of Results
Theoretical		
Sachs and Warner (1999)	-Modified Dutch Disease model -Primary commodities shifts out resources away from other economic sectors	-Natural resource wealth may crowd-out growth-inducing sectors, e.g. manufacturing
Torvik (2001)	-Modified Dutch Disease model -Increasing returns to scale in both sectors: Possibility of learning spillovers	-With sufficiently high learning spillovers, both non-traded and traded sectors may benefit

Caselli (2006)	-Natural resource-abundance causes power struggles (related to incentives of political elites)	-With power struggles, the elite makes less investments in the long-run development of the country
Empirical*		
Sachs and Warner (1995)	-Cross-section of 52 countries -Dutch Disease Effects	-Resource-intensive economies have slower growth in manufactures
Stijns (2003)	-Gravity Model of Trade	-Increase in natural resource exports decreases manufacturing trade
Sala-i-Martin and Subramanian (2003)	-Inclusion of "Institutions" variable (corruption measure)	-Resource-rich countries with good institutions do not suffer from the curse
Mehlum, et al. (2006)	-Interaction term between natural resource endowment and institutional quality	-Resource-rich countries with good institutions do not suffer from the curse
Persson and Tabellini (2003)	-Role of democracies	-Presidential democracies are more prone to the resource curse
Isham, et al (2005) and Auty (1997)	-Distinction between point-source and diffuse natural resources	-Easily appropriable point-source resources negatively affects the economy more
Collier and Hoeffler (2004)	-Resource wealth and conflict relationship	-Resource export-dependent countries are prone to conflict
Brunnschweiler and Bulte (2009)	-Resource wealth and conflict relationship	-Reversed causality: Civil conflict causes natural resource export dependence
Brunnschweiler and Bulte (2008)	-Re-definition of resource endowment: logarithm of natural capital abundance instead of the "usual" resource export dependence measure	-Greater resource abundance causes better institutions and is growth-inducing

*unless otherwise stated, the measure for resource wealth is the share of resource exports over GDP ("resource dependence")

IV. The Emerging Role of Natural Resources in FDI Decisions

Indeed, both natural resource endowment and foreign direct investments may affect economic development. However, the possible effect of natural resources on foreign direct investment has not been thoroughly discussed in economic literature. Only a few recent studies on the topic exist and are synthesized in this section. However, note that all of these, like most of those in the resource curse, focus on the effect of natural resource dependence rather than natural capital. More importantly, none of these studies are related to the pollution haven hypothesis.

In their research analyzing the relationship between capital control policies, e.g. capital account restrictions, on foreign direct investments, Asiedu and Lien (2003) used “natural resource availability” as one of the control variables. They conducted fixed-effects panel data regressions utilizing 96 developing and developed countries and 1970 to 2000 as sampling years. Using the share of fuel (oil) in total exports as measure, they hypothesized a negative relationship between resource availability and FDI inflows. As in the Dutch disease channel discussed above, this is because natural resources may crowd out investments in manufacturing, FDI included. In addition, natural resources like oil are greatly affected by economic volatility. Furthermore, while the exploration for natural resources requires huge initial capital, the continuous operations usually involves small and uncertain cash flows. In the end, Asiedu and Lien (2003) observed that the natural resource dependence variable has a negative coefficient. They noted that natural resource dependence has a negative association with aggregate FDI.

On the other hand, in their paper on FDI determinants, Onyeiwu and Shrestha (2004) examined a panel data of 29 African countries for 1975 to 1999. Similar to Asiedu and Lien (2003), the natural resource control variable was measured as the proportion of fuel exports to total exports. However, they got an exactly opposite finding. Natural resource exports was observed to be positively and significantly correlated with FDI. Using both cross-sectional and panel data regression employing 114 developing and developed countries for 1970 to 1997, this finding is supported by Jensen's (2003)

paper on the democracy-FDI relationship. He also observed that the resource export dependence control variable also has a positive effect on FDI. With striking contrast, they have shown that resource export intensity may not necessarily crowd out FDI.

The difference in the results might be due to the variation in the control variables used in the regressions. It is important to note that Asiedu and Lien (2003) did not control for institutional quality, e.g. corruption or democracy. They only controlled for “political instability” in the form of a proxy (number of industrial union strikes). They failed to directly control for institutional quality. In contrast, Jensen (2003) clearly had an institutional quality variable as his study's main topic is on democracy. Onyeiwu and Shrestha (2004) used a political rights control variable as well. Again, controlling for institutional quality, these papers observed a positive effect on natural resources on FDI. Thus, similar to the institutional channel in the traditional resource curse, decent institutions might mitigate the possible negative effects of resource export intensity.

Finally, whereas most of the aforementioned studies use resource export dependence as control, Poelhekke and van der Ploeg (2010) explicitly studied the relationship between natural resource abundance and sector-specific FDI. However, their study's main focus is on factors which determine FDI from one source country only, the Netherlands, for 1984 to 2002. They used confidential sector-specific data collected by the Dutch central bank. In contrast to past studies, they had accessed to separate non-resource and resource FDI, and industrial-specific data. They also employed a natural resource abundance variable instead of a resource export dependence measure. Resource abundance was measured as total subsoil assets, e.g. total oil and mineral reserves, instead of the usual natural resource exports variable. While subsoil assets have a positive influence on resource FDI, it was found out that it has a negative effect on non-resource foreign direct investment inflows.

In conclusion, with the exception of Poelhekke and van der Ploeg (2010), most of the previously discussed studies investigated the effect of natural resource export dependence on FDI inflows. Like those in the resource curse literature, more exogenous measures of natural resource abundance have rarely been used. However,

Poelhekke and van der Ploeg's study is not without shortcomings. First, since they consider a single source-country, there might be crowding out in the source of financing in some investments. It is possible that highly dominant firms, e.g. Royal Dutch Shell, might prefer to invest in oil-rich countries or sectors throughout. And second, their study has only one source country for FDI, the Netherlands. They used highly confidential datasets as well. On a *general* scale, their findings might not be easily replicable and comparable.

Overall, Table 5 summarizes the few recent empirical studies linking natural resource availability and foreign direct investment.

Table 5: *Few Empirical Papers on the Impact of Natural Resources on FDI.*

Study	Scope	Natural Resource Availability Measure	Impact on FDI
Asiedu and Lien (2003)	-96 developing and developed countries from 1970 to 2000	-Intensity of resource export dependence	-Negative, significant
Jensen (2003)	-114 developing and developed countries for 1970 to 1997	-Intensity of resource export dependence	-Positive, significant
Poelhekke and van der Ploeg (2010)	-193 recipient countries, but only 1 source-country, the Netherlands	-Total natural capital (new abundance measure)	-Significant -Negative on non-resource FDI -Positive on resource FDI

V. Revisiting Firm Location Choice: Do Lax Environmental Regulations and Abundant Natural Resources Both Attract FDI?

From the literature review above, it can be seen that both natural resources and environmental stringency are potential factors determining FDI location decisions. Indeed, there have been numerous recent studies focusing on the impact of environmental stringency on foreign firm location. However, papers on the effect of natural resource abundance on FDI flows have been surprisingly limited. Thus, the next sections of this paper attempt to answer the following question: *How important are natural resources and environmental policy in attracting FDI?* With this question in mind, the contrasting roles of environmental policy and natural resources are briefly discussed.

Consider first the similarities. First, it can be seen that the location decision of FDI can be both influenced by environmental stringency and natural resource availability. Both concern specializations in trade, i.e. countries with lax environmental policies specialize in polluting activities and those rich in resources specialize in primary commodities. Moreover, it is probable that FDI to developing countries with less strict environmental policies and abundant natural resources is “low cost-seeking”. As foreign firms might want to cut on costs, they might prefer to locate in countries with lax policies (a la pollution havens). Arguing on low cost and factor endowment grounds, it can also be said that foreign investors (esp. resource-seeking investors who use natural resources as inputs) may prefer to invest in resource-wealthy countries as well.

Second, another similarity between environmental policy and natural resources is that their impact on foreign firm location choice might be dependent on institutions. Weak institutions may impose additional costs (i.e. in the form of bribes) for pollution-intensive industries. Hence, in the presence of corruption, foreign firms may not necessarily locate in developing countries with lax environmental standards. On the other hand, besides those argued in the resource curse literature, the impact of weak institutions on natural resources can be elaborated by “open access” problems. As a result of open access, harvesters extract natural resources without consideration of the

impact of the smaller stock on other harvesters and future extraction opportunities (Fischer, 2010). In this case, if resource-seeking firms are seeking to make long-term investments, they might prefer to locate in countries with relatively better institutions and less open access problems. Since they may want to extract rents for a longer span of time, resource-seeking investors may invest in countries which can optimally manage natural resource stocks. In the end, resource-seeking foreign firms may prefer resource-rich countries with strict environmental policies and good institutions than those with lax policies, but low-quality political institutions.

Consider now the differences. First, natural resources pose some different challenges than those raised by pollution. Central to this argument is the fact that some natural resources are renewable (e.g. forest resources). While renewable natural resources might be depleted by harvesting activities, biological processes allow them to be replenished over time. In this case, the management of resources is an intertemporal issue. Hence, the static models commonly used in trade and environment analysis (e.g. like those in the pollution haven hypothesis) may pose some limitations (Fischer, 2010).

Second, it can be seen that FDI-related pollution haven hypothesis concerns industries (e.g. manufacturing) that are more mobile and can relocate elsewhere. Moreover, environmental regulatory policies are controllable by host country governments. In order to attract FDI, they can design lax environmental standards. On the other hand, the ability of natural resources to attract FDI is different. The potential scope for mobility of resource-exporting firms is relatively limited. In this case, FDI is largely determined by an uncontrollable factor. Regardless of the policies a country pursues, it is possible that natural resource-poor countries will attract very little or no resource-seeking FDI.

Third, in contrast to lax environmental policy, the ability of natural resources to attract FDI is less obvious. The cost reduction motives discussed above might not be always the case for predominantly market-seeking investors who may deter FDI flows as they may associate natural resource endowment with macroeconomic instability (a la resource curse in growth literature). Meanwhile, it is also possible that pollution be

considered a “new resource curse”. That is, developing countries with low environmental standards fail to attract FDI that are beneficial to economic development. This is possible as low environmental standards may allow industries not to strongly benefit from using more efficient technologies.

Overall, the next sections of this paper utilize the arguments of both the pollution haven hypothesis and the natural resource curse. A preliminary investigation is done by assuming that FDI inflows are affected by both environmental stringency and natural resource availability. Due to data constraints, unlike Poelhekke and van der Ploeg (2010), this study does not make any distinction between non-resource and resource FDI. However, the inclusion of macroeconomic variables like population and the natural capital control variable may help distinguish market-seeking from resource-seeking FDI. In addition, in striking difference to the pollution havens literature, this paper provides a newer and more concrete distinction between resource abundance and dependence. With all of these elements, it is interesting to see whether or not lax environmental policies and natural resource abundance both attract foreign direct investments.

VI. Econometric Models and Regressions Results

A. Estimation Approach and Data Sources

1. Empirical Strategy

The empirical analysis covers 40 developed and developing countries (see Appendix A). Due to data constraints, cross-country regressions are conducted. To mitigate measurement error issues and to account for long-run relationships among variables, the values for most of the economic variables (dependent and independent) are averaged for 2003 to 2007 (if not otherwise mentioned). To avoid reverse causality and other endogeneity issues, lagged data for independent variables like institutions and natural resource exports are used. Lags are also employed for some macroeconomic variables like GDP (average lagged values using 1998 to 2002 data). Lastly, average lagged values for 1996 to 2000 were used for alternative environmental stringency measures like sulfur emissions. As for the dependent variable (FDI), logged net FDI inflows are used instead of FDI share over GDP. This is done following the papers by van der Ploeg and Poelhekke (2010) and Asiedu and Lien (2003). The use of logged FDI inflows was also justified as the author found out that degree of fit or the explanatory power (R-squared) of the regressions were higher than when other FDI measures (e.g. FDI as a share of GDP) are used. For more details on the justifications for the specification of all other variables, please refer to the *subsections of Part VI.A.2*.

To check how the main variables in this study (ENVIRONMENTAL STRINGENCY and NATURAL RESOURCES) affect the most basic FDI regressions, a step-by-step approach is employed. First, an OLS regression of the most common macroeconomic determinants of FDI is estimated excluding the above mentioned variables. After this, the variables of interest are added. Following both pollution haven hypothesis and resource curse literatures, institutional quality is then accounted for. Lastly, robustness checks like interaction terms, instrumental variables, and alternative measures are conducted.

Unless otherwise stated, most of the datasets were retrieved from the World Bank's *World Development Indicators* website. For a summary of the descriptive statistics of some variables, please refer to Appendix B.

2. Description of Data

i. Dependent Variable

The dependent variable, FDI, is the logged level of FDI net inflows into a country, measured in current U.S. dollars. According to the *World Development Indicators*, FDI net inflows are investment to acquire a lasting management interest (at least 10 percent of the voting stock) in an enterprise located in a country other than that of the investor. It includes equity capital, earnings reinvestment, and other forms of capital as shown in the balance of payments. As Jensen (2003) mentioned, net FDI inflows must not be confused with overall net FDI flows. Because this paper only focuses on a country's ability to attract investment from abroad, net FDI *inflows* is a more appropriate measure. Overall net FDI *flows* are total FDI inflows of foreign capital minus total outflows of domestic capital. In contrast, net FDI inflows, only measures the change in the position of foreign investors in a country. Thus, net FDI inflows seem to be a better measure of a country's ability to attract foreign capital. Following van der Ploeg and Poelhekke (2010), since all of the averaged data exhibited positive net inflows, the logarithm of the level of FDI inflows is taken. This was done to avoid reduce the impact of outliers.

ii. Main Independent Variables

a. Environmental Stringency

To test for the pollution haven hypothesis, this paper uses the logged value of the 2006 Environmental Performance Index (EPI) as a proxy for the stringency of environmental regulation (ENVIRONMENTAL STRINGENCY). Compared to previous studies, this paper uses this relatively new measure as it is based on multiple local environmental policy-related criteria, e.g. lead emissions, water quality, nutrient loading, and the like. Unlike usual proxies like sulfur emissions, it might also be less prone to endogeneity issues. It is also assumed that environmental performance do not

immediately change in a short span of time, e.g. 5 years as used by the 2003 to 2007 averaged variables.

Cross-country EPI data were constructed by the Yale Center of Environmental Law and Policy. The Environmental Performance Index ranks countries on 25 performance indicators tracked across ten policy categories covering both environmental public health and ecosystem vitality. It is assumed that a higher EPI score implies stricter environmental policies. Overall, with EPI as a proxy for environmental regulation, ENVIRONMENTAL STRINGENCY is expected to have a negative impact on net FDI inflows. Countries with less strict environmental policies might have a comparative advantage in polluting activities. Following the pollution haven hypothesis, to save on production costs, foreign firms might decide to relocate to them.

At the latter part of the paper, SULFUR EMISSIONS is used as an alternative proxy for environmental stringency. Country data for sulfur emissions (in thousands of metric tons of sulfur) were obtained from the website of Dr. D. Stern of Australian National University. The datasets are composed of continuous time series using a combination of published and reported estimates. For this paper, the average of the most recent 1996 to 2000 sulfur emissions data was taken. To avoid skewedness in distribution, the logarithm of these averaged values was used. It is argued that higher sulfur emissions may imply less stringent environmental regulation and may thus attract more FDI inflows.

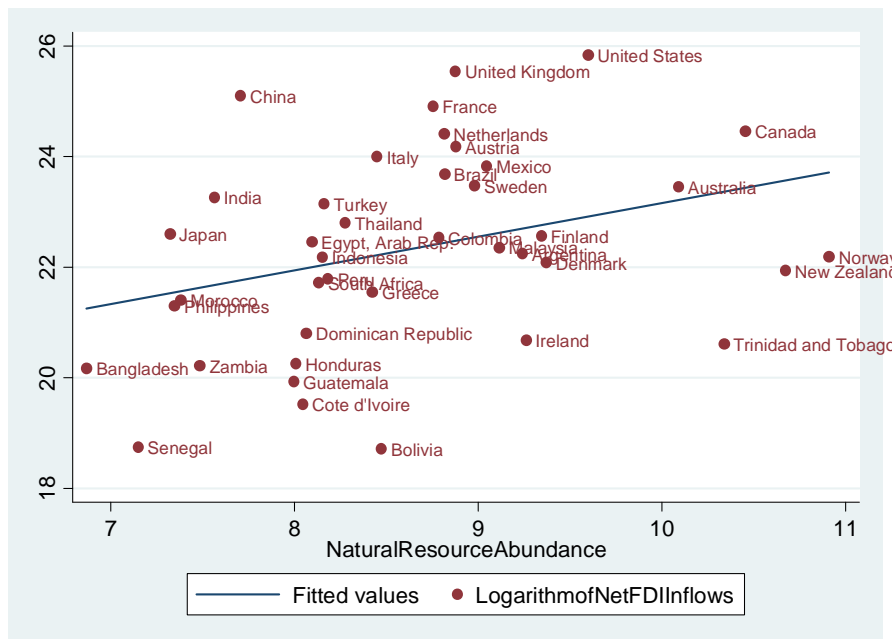
b. Natural Resources

To control for resource-wealthy countries, a natural resource variable (NATURAL RESOURCES) is used. In contrast to previous studies, this study explicitly compares two measures of natural resource endowment. The first one follows traditional resource curse literature by using natural exports as a share of GDP. This is labeled as a measure for RESOURCE DEPENDENCE. It is the sum of mineral and agricultural raw material exports as a share of GDP, averaged over 1970 to 1989. Following economic literature and to be consistent with other percentage data (e.g. TRADE AND HUMAN CAPITAL),

it is measured in proportion terms ranging from 0.0 to 1.0. This was done for consistency purposes. Meanwhile, the alternative variable is RESOURCE ABUNDANCE. Resource abundance is defined as the logarithm of total natural capital, estimated in US dollars per capital for 2000. It includes subsoil assets (e.g. oil and minerals), timber and other forest resources, non-timber resources, cropland, and the like. Resource dependence and abundance data were obtained from the datasets of Brunnschweiler and Bulte (2008: <http://www.cer.ethz.ch/resec/people/bchrista>).

Regarding the sign of the coefficient of the NATURAL RESOURCE variable, this paper assumes that it may have a positive association with FDI, *ceteris paribus*. Indeed, Figure 1 shows that natural resource *abundance per se* is positively correlated to FDI inflows. Arguing on endowment grounds, natural resource wealth may attract FDI, especially resource-seeking capital.

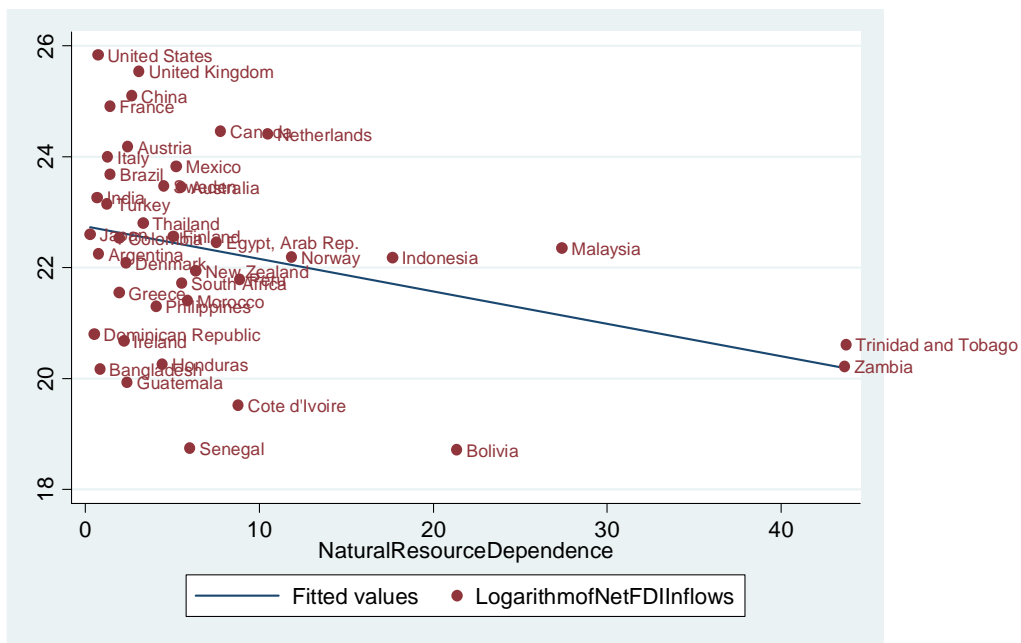
Figure 1: Correlation between Resource Abundance and FDI.



In contrast, Figure 2 presents the negative correlation between natural resource dependence and FDI. Note that for this graph *only*, resource dependence is shown in the 0 to 100 percentage range (i.e. unlike the proportion-based percentage range used in all the regression analysis). Following the resource curse, foreign capital might be

hindered as natural resource *dependence* is sometimes associated with the Dutch Disease and social instability. However, following previous literature, note that resource dependence can be mediated by institutional quality. Resource-dependent countries which can enforce contracts and protect property rights efficiently may eventually attract more FDI.

Figure 2: Correlation between Resource Dependence and FDI.



iii. Other Independent Variables

To better explain FDI, other economic variables are used as controls. Based on the dependent variable, these were chosen based on the paper by van der Ploeg and Poelhekke (2010). OPENNESS TO TRADE, HUMAN CAPITAL, MARKET SIZE, ECONOMIC DEVELOPMENT, and INSTITUTIONAL QUALITY are used as control variables. Note that these exact explanatory variables are also common to past FDI-related studies (Li and Resnick (2003); Asiedu and Lien (2003)).

Following existing FDI literature, OPENNESS TO TRADE is measured as exports plus imports as a proportion of GDP. It is expected to have a positive effect on FDI. Greater openness to trade may imply a more conducive economic environment for

foreign investors. Another component which can induce FDI inflows is HUMAN CAPITAL. In this paper, quality of human capital is defined as the share of population aged 15 or over with complete primary education for 2000. The dataset was obtained from Soto and Cohen (2007). It is argued that the more educated the population is, the more foreign capital is attracted. Furthermore, the coefficient of MARKET SIZE is also expected to have a positive sign. To avoid skewed distribution, market size is measured by the log of total population. Intuitively, a larger market size will obviously attract market-seeking FDI inflows. Finally, ECONOMIC DEVELOPMENT, measured as the logarithm of GDP per capita (in constant 2000 USD), is expected to have a positive impact on FDI inflows as well. Since economic development implies better consumer purchasing power, capital endowment, and infrastructure, more developed countries are expected to attract FDI than less-developed ones (Li and Resnick, 2003). To avoid reverse causality issues (FDI-led development instead of development-led FDI) and following existing literature (van der Ploeg and Poelhekke, 2010), the data used were averaged values from 1998 to 2002.

In both strands of pollution haven hypothesis and resource curse studies, INSTITUTIONAL QUALITY seems to be a usual control variable. In this paper, it is a proxy measured by the “rule of law” variable from Brunnschweiler and Bulte (2008) resource curse paper. Using 1996 data ranging from scores of -2.5 to 2.5, it captures perceptions of the quality of contract enforcement, property rights, the police and the courts, as well as the likelihood of crime and violence. Despite its limited range, following Brunnschweiler and Bulte (2008), this institutional quality measure is assumed to satisfy normality assumptions. Despite the contrasting expected impact of institutions on FDI discussed in the literature review, this paper proposes that countries with high-quality institutions tend to attract more FDI (as in Arezki and van der Ploeg (2006) in the resource curse literature and Javorcik and Wei (2004) in the pollution havens literature).

B. Ordinary Least Squares Regressions

1. Benchmark Results

The first set of regressions involves cross-sectional Ordinary Least Squares (OLS) estimation. To correct for heteroskedasticity, robust standard errors are utilized. As explained above, the baseline regression (Equation 1) only uses macroeconomic control variables which are common to almost all FDI-related literature (Li and Resnick, (2003), van der Ploeg and Poelhekke (2010), Asiedu and Lien (2003), etc.). The baseline regression is the following:

$$\text{FDI} = \alpha_0 + \alpha_i^* \text{macroeconomic control variables} + \text{error term} \quad (\text{Equation 1})$$

To test for the pollution havens hypothesis, ENVIRONMENTAL STRINGENCY is added as an explanatory variable to Equation 1. Furthermore, arguing that the effect of the stringency of environmental policy on FDI might also differ between resource-rich and resource-poor countries, Equation 1 is then extended by incorporating a natural resource availability variable (see Eq. 2). As implied in the previous sections, natural resource availability is comparably tested using different measures for resource abundance (log total natural capital) and dependence (natural resource exports as a percentage of GDP).

$$\text{FDI} = \alpha_0 + \alpha_1 \text{Environmental Stringency} + \alpha_2 \text{Natural Resources} + \alpha_i^* \text{controls} + \text{error term} \quad (\text{Eq. 2})$$

Finally, following the pollution haven hypothesis and the resource curse literature, institutional quality is then controlled for (Eq. 3).

$$\text{FDI} = \alpha_0 + \alpha_1 \text{Environmental Stringency} + \alpha_2 \text{Natural Resources} + \alpha_3 \text{Institutional Quality} + \alpha_i^* \text{controls} + \text{error term} \quad (\text{Eq. 3})$$

The OLS empirical results are presented in Table 6. The baseline regression, Regression 1, shows that the usual macroeconomic determinants in FDI literature are significant. With high significance, market size and level of economic development are positively correlated with FDI inflows. This result implies that FDI inflows might be market-seeking. This is because a higher population means a better market potential for foreign investors. Moreover, they may also be attracted to countries with a high level of

development, i.e. higher purchasing power. Meanwhile, openness to trade is weakly significant. It is likely that conditions for a better investment environment may overlap with conditions for a better international trade environment. In contrast, the quality of human capital was found to be insignificant. However, it is characterized by an expected positive coefficient. A more educated labor force has an insignificantly positive association with FDI.

Table 6: Benchmark OLS regressions exhibiting the determinants of FDI.

Dependent Variable: FDI

Explanatory Variable	Regression (1): Coeff. (Robust S.E.)	(2) Coeff. (Robust S.E.)	(3) Coeff. (Robust S.E.)	(4) Coeff. (Robust S.E.)	(5) Coeff. (Robust S.E.)	(6) Coeff. (Robust S.E.)	(7) ### Coeff. (Robust S.E.)	(8) Coeff. (Robust S.E.)
Natural Resources:								
Resource Dependence				2.22721** (1.3411)		1.872*** (1.3550)		2.25962* (1.1966)
Resource Abundance			.38217*** (.257135)		.34043*** (.262958)		.5365785* (.261322)	
Environmental Stringency		1.671728 (1.345348)	1.216885 (1.33939)	1.732**** (1.28290)	2.1105**** (1.59958)	2.60660* (1.5284)	3.033789* (1.44675)	3.249963* (1.63011)
Openness to Trade###	.52307**** (.3827)	.43441 (.4239)	.49071 (.45189)	.34631 (.4613)	.28006 (.48956)	.14617 (.45808)	4.57031* (2.43932)	2.6825**** (1.96434)
Human Capital	.9610 (0.9410)	.8453 (.98637)	.69646 (.88549)	.59602 (.99847)	.88516 (.86906)	.81629 (1.00134)	.83354 (.84919)	.77432 (1.01451)
Market Size	.8777727* (.0964667)	.9079679* (.1050549)	.970011* (.0905095)	.971481* (.1209891)	.9683376* (.0889623)	.966715* (.121408)	1.203523* (.1479761)	1.101801* (.1343321)
Economic Development	.9528768* (.105336)	.7875223* (.1786575)	.6769325* (.2142534)	.8286977* (.1743991)	.3580582 (.3086862)	.47555*** (.2963571)	.1361853 (.2888796)	.3910464 (.3217588)
Institutional Quality					.415840*** (.2590645)	.43548** (.2387321)	.4541508* (.237866)	.458212*** (.2509071)
Constant Term	-1.421598 (2.204545)	-7.590**** (5.349989)	-9.08921** (5.340642)	-9.3335** (5.44097)	-9.97136** (5.55342)	-10.151** (5.798931)	-18.2568* (6.69531)	-14.8285* (6.55304)
R-Squared	0.80	0.81	0.82	0.82	0.83	0.83	0.86	0.84

*significant at the 5% level.**significant at the 10% level. ***significant at the 15% level.****significant at the 20% level.
Regression 1 to 6 employs the usual exports plus imports over GDP measure for "Openness to Trade". But, to control for multicollinearity and avoid endogeneity problems, the *constructed trade share* measure predicted by the gravity model of Frankel and Romer (1999) is eventually used (starting from Regression 7 until Regression 17 below).

Regression 2 shows that environmental stringency has a positive impact on FDI inflows. Like previous empirical studies (Levison (1996) for example), the pollution haven hypothesis is not supported. Although insignificant, the positive coefficient of ENVIRONMENTAL STRINGENCY may suggest that investors are attracted to countries with strict environmental policies. Meanwhile, controlling for natural resource endowment, Regressions 3 and 4 still show that environmental stringency is positively associated with FDI. It does, however, becomes weakly significant in resource-dependent countries.

Looking closely at Regressions 3 and 4, contrary to the resource curse, both natural resource measures have a positive correlation with FDI. However, resource abundance is weakly significant only at the 15% level. In contrast, resource dependence is significant at a higher 10% level. The positive signs of the coefficients of these two measures imply that the resource curse does not apply to FDI. Some FDI inflows seem resource-seeking, especially for resource export-dependent countries. Intuitively, resource-dependent countries are more likely to attract resource-seeking FDI than other types of FDI. To attract higher profits, this seems logical as natural resource-dependent countries might employ laxer foreign investment policies (e.g. less administrative work in acquiring mining licenses). Indeed, countries dependent on natural resource exports might also be dependent on resource-seeking FDI. Hence, they may offer a less costly investment environment to foreign investors in the primary commodities sector.

After this, following both the procedure of previous pollution havens and resource curse studies, the quality of institutions is then controlled for. Accounting for institutional quality, the impact of environmental stringency on FDI remains significant. Furthermore, note that institutional quality is weakly significant for resource-abundant countries and significant at the 10% level for resource-dependent countries. This supports the notion that “institutions matter”. In particular, foreign investors might be more attracted to countries which are less corrupt, can facilitate contracts efficiently, and protect property rights more.

Overall, as for the other macroeconomic variables, Regressions 3 to 6 reflect the econometric findings from the most basic regression, Regression 1. As for the usual macroeconomic determinants of FDI, it was observed that market size remain a highly important determinant of FDI (as in Regression 1). In contrast, focusing on Regressions 5 and 6, the relevance of the level of economic development in attracting FDI diminishes once good institutions are accounted for. This can be explained by two alternative reasons. First, once institutional quality is controlled for, this may imply that a country’s level of development is becoming less important in the location decision of foreign investors. Second, it is possible that economic development was capturing in part the role of institutional quality when the institutions variable was omitted.

Lastly, contrary to most FDI literature, trade openness is now observed as insignificant. This result can be explained by two reasons. First, resource export dependence may capture some of the effects by trade openness. Second, trade as a share of GDP might suffer from endogeneity problems (Frankel and Romer, 1999). Following growth literature, countries who attract FDI more (for reasons other than trade) may open their economies more. That is, there might be a feedback effect. To mitigate for this, unlike previous FDI literature, OPENNESS TO TRADE is then measured by a proxy (*from Regression 7 until Regression 17 in the following discussion below*). This proxy is a “1985 constructed trade share” measure acquired from the gravity model in Frankel and Romer’s 1999 paper. Their model is based on geographic variables that can be used to construct an instrument for international trade. They noted that geographic variables, e.g. common border, are not affected by incomes and other income-related factors like FDI inflows. The Frankel-Romer trade measure was constructed using a bilateral trade equation dependent on instrumental variables like the country’s land area and a landlocked dummy. The use of this measure is supported by the paper by Irwin and Tervio (2002). They find that the Frankel-Romer measure is robust to different time periods.

Regressions 7 and 8 start the use of this trade proxy. They both show that, indeed, openness to trade becomes again a significant determinant of FDI (as in Regression 1). It is strongly and weakly significant for resource-abundant and resource-dependent countries, respectively. Also, both regressions still reflect the results for the other macroeconomic quality variables in Regressions 5 and 6. More importantly, the coefficient of institutional quality, environmental stringency, and natural resources are now highly significant at the 5% level.

2. Summary of Preliminary Analysis

In conclusion, accounting for natural resource endowment, it has been shown by Regression 7 and 8 that environmental stringency is an important determinant of FDI location choice. Resource-seeking foreign investors may tend to prefer resource-rich economies with strict environmental policies and good institutions. This paper offers

several potential reasons supporting this finding. First, it is possible that the low-cost benefits of access to natural resources and high-quality institutions (e.g. less corruption) are more important than the cost reduction caused by lax environmental regulation. Second, it can be explained by the fact that the exploration and extraction of natural resources require large-scale, capital-intensive investment (i.e. high sunk costs) (van der Ploeg and Poelhekke, 2010). If FDI inflows are mostly resource-seeking, then the preference of foreign firms to locate in countries with strict environmental policies and abundant resources may be reasonable. While low cost operations could be an objective of FDI, from the *long-term* perspective, foreign investors in capital-intensive resource sectors may seek *properly implemented* environmental standards rather than lax environmental policy *per se* (Aliyu, 2005). Third, in responding to changing environmental standards, note that only firms whose capital is mobile could migrate. Other relatively immobile firms may use time rather than location to respond to the adverse impact of policy changes. This is particularly relevant for FDI directed to the natural resources sector. As they dynamically optimize the timing of their production processes (e.g. exploration and extraction), resource-seeking foreign firms may prefer to have long-term investments in countries with strict, yet consistent environmental regulations.

C. OLS with Interaction Terms

As in Brunnschweiler (2006) in the resource curse literature, this paper extends Equation 3 by examining the interaction between natural resource availability and institutional quality. Although natural resources might have positive effects on FDI inflows, the results might have been driven by resource-rich countries with high-quality institutions. To investigate this possibility, Equation 4 is formulated by incorporating an interaction term. Equation 4 is modeled as follows:

$$FDI = \alpha_0 + \alpha_1 \text{Environmental Stringency} + \alpha_2 \text{Natural Resources} + \alpha_3 \text{Institutional Quality} + \alpha_4 (\text{Institutional Quality} * \text{Natural Resources}) + \alpha_5 * \text{controls} + \text{error term} \quad (\text{Eq. 4})$$

Table 7 summarizes the results. As shown in Regressions 9 and 10, the coefficient signs and significance of the natural resource variables retain their signs. When controlling for resource-endowed countries with high-quality countries through the interaction term, resource abundance is strongly significant whereas resource dependence becomes weakly significant. Furthermore, the variable controlling for environmental regulation remains significant. The other economic variables, e.g. trade openness and market size, have almost the same signs and significance as in the previous regressions. Similar to Regressions 7 to 8, once institutional quality is controlled for, the effect of the lagged measure for economic development diminishes and becomes insignificant.

Table 7: OLS regressions (with interaction terms) exhibiting the determinants of FDI.

Dependent Variable: FDI

Explanatory Variable	(9) Coeff. (Robust S.E.)	(10) Coeff. (Robust S.E.)
Natural Resources:		
Resource Dependence		2.00769*** (1.34823)
Resource Abundance	.6315069* (.2565499)	
Environmental Stringency	2.817229* (1.406046)	3.103707** (1.775962)
Openness to Trade	4.48309** (2.54784)	2.437 (2.01334)
Human Capital	.76848 (.88294)	.81679 (1.01173)
Market Size	1.193342* (.1577588)	1.091722* (.1409201)
Economic Development	.1009847 (.2940978)	.3976649 (.3274346)
Institutional Quality	1.209283 (1.41116)	.3733657*** (.2535449)
Interaction Term: Natural Resources*Institutional Quality	-.0808995 (.1458721)	1.73727 (2.52678)
Constant Term	-17.6352* (6.890867)	-14.0417* (7.39442)
R-Squared	0.86	0.84

*significant at the 5% level. **10%. *** 15%.**** 20% level.

Note that the coefficients of the interaction terms in Regressions 9 and 10 have different signs. This is in addition to the finding that resource abundance is strongly significant, while resource dependence is weakly significant. Moreover, the results imply that institutional quality matters more for resource export-dependent countries than for those which are only resource-abundant.

The results from Regression 9 are the opposite of that found by Mehlum et al (2006) in their resource curse paper. Based on Regression 9, the net impact of natural resource abundance on FDI is found in Eq. 5.

$$\delta FDI / \delta \text{Resource Abundance} = \alpha_2 + \alpha_4 \text{Institutional Quality} \quad (\text{Eq. 5})$$

The effect of resource abundance on FDI is only positive at certain values of institutional quality. Using the coefficients in Regression 5, $\delta FDI / \delta \text{Resource Abundance}$ is greater than zero when the following is satisfied: $0.637 - 0.080(\text{Institutional Quality}) > 0$. Resource abundance is noted to have a positive effect on FDI inflows when the value for institutional quality is less than 7. Note that the institutional quality variable's range is only from -2.5 to 2.5. According to Regression 9, institutional quality might not influence the role played by resource abundance in attracting FDI. This is in strong contrast to the seemingly relevance of institutions found in resource-dependent countries (Regression 10).

Regression 10 reflects the result found by Mehlum, et al (2006) in the traditional resource curse literature. Resource-dependent countries with high-quality institutions tend to attract more foreign direct investments. As institutional quality increases, resource export-dependent countries may rely less on resource-seeking FDI. Based on Regression 10, the net impact of natural resource abundance on FDI is calculated by Equation 6 below:

$$\delta FDI / \delta \text{Resource Dependence} = \alpha_2 + \alpha_4 \text{Institutional Quality} \quad (\text{Eq. 6})$$

Applying coefficients from Regression 10 to Eq. 6, resource dependence only has a positive association with FDI when a country has an institutional quality score greater than -1.17. The regression predicts that countries with rule of scores less than -1.17 tend to suffer from what can be perceived as the resource curse. That is, resource dependence impede FDI inflows in countries with low enough institutional quality. Using the original dataset of Brunnschweiler and Bulte (2008), countries with scores below the

threshold of -1.17 (like Somalia and Laos) may suffer from the adverse effect of bad institutions. On the other hand, as Regression 8 previously showed, Regression 10 implies resource-dependent countries with high-quality institutions tend to attract FDI. With good institutions, however, countries may slightly rely less on resource-export oriented FDI. This is supported by the small decrease in the magnitude of the RESOURCE DEPENDENCE's coefficient from 2.25 in Regression 8 to 2.00 in Regression 10.

D. Alternative Estimations

In this section, a few alternative estimations for the base OLS Regressions (Regressions 7 and 8) are conducted. These include the use of alternative stringency measures and Instrumental Variable Two-Stage Least Squares (IV-2SLS) estimation.

1. Using Sulfur Emissions as Alternative Environmental Stringency Proxy

To further test the pollution havens hypothesis, the log of sulfur dioxide emissions is used as an alternative proxy for ENVIRONMENTAL STRINGENCY (see Xing and Kolstad (2001), for example). The use of sulfur dioxide emissions as an indicator of environmental stringency is supported by Quiroga et al (2007). First, sulfur emissions measures are output-oriented. That is, sulfur is emitted as a result of production. Second, abatement technologies are available to regulate its emissions. Third, it is subject to local regulations. This is because it has direct effects on both the environment and human beings. Overall, following the pollution haven hypothesis, it is argued that higher sulfur emissions will imply less strict environmental regulation and more FDI inflows.

Table 8: OLS regressions with sulfur emissions as environmental policy proxy.

Dependent Variable: FDI

Explanatory Variable	(11) Coeff. (Robust S.E.)	(12) Coeff. (Robust S.E.)
Natural Resources:		
Resource Dependence		1.7759\$ (1.53171)
Resource Abundance	.5393511* (.2417171)	
Sulfur Emissions	.2096003 (.1614537)	.1871303 (.2131864)

Openness to Trade	4.97629** (2.7533)	2.8114 (2.59137)
Human Capital	.74297 (.76916)	.799 (.9608)
Market Size	.9384725* (.1753921)	.825128* (.2587882)
Economic Development	.4594317* (.1871842)	.7274815* (.229772)
Institutional Quality	.2963697*** (.2010507)	.3120315**** (.2384113)
Constant Term	-4.534983 (3.593505)	.0893679 (4.761921)
R-Squared	0.85	0.82

*significant at the 5% level,**10%. *** 15%.**** 20% level. \$ only becomes significant at the 25% level.

Focusing on the coefficient for SULFUR EMISSIONS (alternative environmental policy proxy), Regressions 11 and 12 show that higher emissions tend to attract FDI inflows. This is shown by the positive coefficient of SULFUR EMISSIONS. However, it is insignificant. Hence, like the results for the Environmental Performance Index (original ENVIRONMENTAL STRINGENCY measure), the pollution haven hypothesis is not supported. This is consistent with the usual findings in the survey of literature in Section II.B.

However, another interesting part is the differences between the results for the two environmental stringency measures. Note that for the original environmental stringency proxy, Environmental Performance Index (EPI), higher environmental regulation was noted to be a highly significant determinant of FDI. On the other hand, the sulfur emissions proxy was found to be insignificant. Some possible reasons can provide explanation for this discrepancy. First, EPI is an aggregate index which accounts for a country's overall environmental performance. In comparison to SULFUR EMISSIONS, it has a more comprehensive scope. EPI covers policy scores for water quality (biological oxygen demand), lead concentration, nitrogen emissions, and other local pollution indicators. In contrast, sulfur emissions might only be specific to sulfur-intensive industries especially those in the energy and manufacturing sectors. Second, due data constraints, the sulfur emissions proxy used in this study was not normalized for energy consumption. For instance, studies like those by Quiroga et al (2007) used sulfur emissions divided by the share of oil consumption on total energy use. Hence,

provided that the time frame is small and endogeneity issues are thus avoided, the use of EPI as the aggregate measure for the stringency of environmental policy is preferred.

2. Focusing on Point-Source Mineral Resources

In contrast to diffused (or not concentrated) resources like agricultural products, Brunnschweiler and Bulte (2008) noted that point-source resources (e.g. mineral resources like oil and crude fuel) have more relevant importance for institutional and economic development. As shown by the survey of literature in Part III, this is because point-source resources' cash flows are more "appropriable". With this notion, this section conducts econometric regressions using mineral resources variables *only*.

The alternative natural resource variables are labeled under MINERAL RESOURCES. Using data from Brunnschweiler and Bulte's (2008) paper, MINERAL DEPENDENCE is measured as the GDP share of total yearly mineral exports, defined as the sum of mineral fuels, ores, and metal exports, averaged over 1970 to 1989. On the other hand, MINERAL ABUNDANCE is measured as the log of subsoil assets, estimated in US\$ per capita for 2000. The measures include energy resources (oil, natural gas, hard coal, lignite), and other mineral resources (bauxite, copper, gold, iron, lead, nickel, phosphate, silver, tin, and zinc).

Table 9: OLS regressions focusing on point-source mineral resource measures.

Dependent Variable: FDI

Explanatory Variable	(13) Coeff. (Robust S.E.)	(14) Coeff. (Robust S.E.)
Mineral Resources:		
Mineral Dependence		2.530309* (.9920327)
Mineral Abundance	.1612078* (.0745108)	
Environmental Stringency (original EPI proxy)	3.389284* (1.586942)	3.621078* (1.564718)
Openness to Trade	3.65884** (2.10209)	2.76107**** (1.95451)
Human Capital	.99911 (.84672)	.72103 (1.02628)
Market Size	1.0658* (.1128738)	1.116509* (.1307305)
Economic Development	.1344249 (.3112972)	.3294652 (.3139354)
Institutional Quality	.5818848* (.2385583)	.5019134* (.246264)
Constant Term	-13.77772* (6.356763)	-16.15057* (6.249074)

R-Squared	0.86	0.84
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*significant at the 5% level. **10%. *** 15%. **** 20% level.

Regressions 13 and 14 reflect the usual results from previous estimations. Market size, environmental stringency, and openness to trade remain significant determinants of FDI. The particular importance of mineral resources for FDI is then shown by the high significance of the coefficients for institutional quality and both resource measures (MINERAL DEPENDENCE and MINERAL ABUNDANCE). While most of the previous natural resources variables (i.e. the original variables which accounted for total natural resources as the sum of all diffuse (e.g. agricultural and forest resources) and point-source (e.g. subsoil assets like oil) natural resources, the measures focusing on mineral resources *only* are highly significant at the 5% level. Institutional quality also becomes highly significant once the “more appropriable” point-source resources like minerals and oil are accounted for.

3. Instrumental Variable Two-Stage Least Squares Estimation

This section follows Brunnschweiler (2006) where only regressions without the interaction terms are re-estimated (Regressions 7 and 8). The IV-2SLS robustness checks are done using the *original* environmental stringency and natural resource availability variables. Instrumental variables are employed because institutions may potentially be endogenous. That is, institutional quality might be the result of growth (and growth-related variables like FDI) rather than the cause. To overcome this potential endogeneity, instrumental variables are used to account for the institutions variable, INSTITUTIONAL QUALITY. Following growth literature, the instruments used in this paper are latitude and French legal origin dummy (Acemoglu, Johnson, and Robinson, 2001). Latitude is a popular instrument because temperate zones (relatively higher latitudes than those near the equator) have better climates and productive agriculture. As a consequence, it was easier for these countries to develop their economies, and possibly their institutions. On the other hand, legal origins (British or French) were also noted to have a potential effect on institutional quality. French law prevented jurisprudence, whereas British law evolved to protect private property owners. Following

some of the results from Acemoglu, Johnson, and Robinson (2001), countries with French legal origins might be associated with worst institutions.

For the first stage of the IV-2SLS, INSTITUTIONAL QUALITY is predicted using Eq. 7 below. As for the second stage, for both natural resource measures, Equation 3 is re-estimated using the predicted values of INSTITUTIONAL QUALITY from Eq. 7.

Institutional Quality = $\beta_0 + \beta_1 \text{Latitude} + \beta_2 \text{French Legal Origin Dummy} + \text{error term}$ (Eq.7)

Table 10: IV-2SLS regressions exhibiting the determinants of FDI.

Second Stage:

Dependent Variable: FDI

Explanatory Variable	(15) Coeff. (S.E.)	(16) Coeff. (S.E.)
Natural Resources:		
Resource Dependence		2.09439**** (1.57054)
Resource Abundance	.5303264** (.2066093)	
Environmental Stringency	3.132734** (1.654128)	3.483598* (1.764319)
Openness to Trade	4.5441* (1.98466)	2.65195**** (1.91864)
Human Capital	.85367 (.88492)	.83797 (.96874)
Market Size	1.204836* (.146469)	1.103662* (.1488417)
Economic Development	.0929914 (.3420219)	.2760796 (.383723)
Institutional Quality#	.5156563**** (.4035444)	.6088317**** (.4387865)
Constant Term	-18.32233* (6.962948)	-14.97911* (7.244808)
R-Squared	0.86	0.83

First Stage:

Dependent Variable: Institutional Quality

	Coeff. (S.E.)
Latitude	3.632233* (.4795049)
French Legal Origin Dummy	-.5680834* (.1932374)
Constant Term	-.3304535*** (.2362989)
R-Squared	0.72

*significant at the 5% level. **10%. *** 15%.**** 20% level. #Instrumented Variable.

Table 10 presents the results of the 2SLS estimation's first and second stage regressions. The first stage regression shows that latitude and French legal origins are good instruments for institutional quality. The second stage regression in both

Regressions 15 and 16 generally obtain similar results to that of Regressions 7 and 8. However, the impact of institutions on FDI was observed to be weakly significant.

4. Controlling for Potential Outliers

The presence of outliers can change the magnitude of regression coefficients. Thus, in this section, a robustness check controlling for outlying observations is performed. From Figure 1 in Section VI.A.2.ii.b, it can be seen that FDI regressions related to resource abundance is not prone to outliers. This is in comparison to Figure 2 which exhibits the possible existence of outliers in the resource dependence-FDI relationship. Based on the graph, it is possible that country data far from the sample mean (Indonesia, Bolivia, Malaysia, Trinidad and Tobago, and Zambia) might dramatically influence the regression results. To take into account the impact of outliers in the resource dependence-FDI relation, the IV-2SLS Regression 16 is re-estimated with an additional variable (OUTLIER DUMMY). Following Choi's (2009) paper on democracy and FDI, outlying observations are controlled for using a dummy variable. In this paper, OUTLIER DUMMY is equal to one for the abovementioned countries. It is zero otherwise.

The results are exhibited in Regression 17 in Table 11. The significance of OUTLIER DUMMY at the 5 % level implies that outliers may have an influence on the regression results. Without the dummy variable, the existence of outliers seemed to decrease the impact of resource dependence on FDI. This is further supported by the change in the magnitude of the coefficient of RESOURCE DEPENDENCE. Controlling for outlying observations, it increased from 2.09 (Regression 16) to 9.13 (Regression 17). More importantly, resource export dependence is not anymore weakly significant. In fact, its impact on FDI is now significant at the 5% level. Finally, other control variables like environmental stringency retain their significance as well.

Table 11: *IV-2SLS regressions controlling for potential outliers.*

Second Stage:

Dependent Variable: FDI

Explanatory Variable	(17) Coeff.
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	(S.E.)
Resource Dependence	9.13045* (2.91008)
Environmental Stringency	4.831163* (1.658101)
Openness to Trade	2.861** (1.73491)
Human Capital	.59774 (.87998)
Market Size	1.223863* (.1411314)
Economic Development	.18936 (.3469051)
Institutional Quality#	.5078063**** (.3994732)
Outlier Dummy	-2.269606** (.8138944)
Constant Term	-22.21509* (7.034085)
R-Squared	0.87

*significant at the 5% level.**10%. *** 15%.**** 20% level. #Instrumented Variable.

5. Instrumental Variable Three-Stage Least Squares Estimation

Finally, this section tries to analyze the possible link between resource abundance and dependence. The impact of resource dependence on FDI might be mediated by resource abundance. It is thus assumed that resource export dependence may be best treated as an endogenous variable. Using again the data from Brunnschweiler and Bulte (2008), the endogeneity of RESOURCE DEPENDENCE is accounted for using Instrumental Variable Three-Stage Least Squares (IV-3SLS) regression. Controlling for conditioning variables like HISTORIC OPENNESS (averaged sum of exports and imports over GDP from 1950 to 1969), RESOURCE DEPENDENCE is likely to be determined by RESOURCE ABUNDANCE and INSTITUTIONAL QUALITY. Resource export dependence “is likely to be positively influenced by resource abundance due to comparative advantage arguments. But, institutions may also matter, because they influence policy making and affect incentives to invest and develop industrial or formal services sectors and thereby reduce the dependence on resources (Brunnschweiler and Bulte, 2008, pg. 251).”

Similar to Section VI.D.3, INSTITUTIONAL QUALITY is predicted using Equation 7. In contrast, RESOURCE DEPENDENCE is now considered endogenous and is estimated using Equation 8. To find the determinants of FDI (Equation 3), the third stage then uses the predicted values from the previously mentioned equations.

$$\text{Resource Dependence} = \chi_0 + \chi_1 \text{Resource Abundance} + \chi_2 \text{Institutional Quality} + \chi_3 \text{Historic Openness} + \text{error term} \quad (\text{Eq.8})$$

Table 12: IV-3SLS accounting for the possible endogeneity of resource dependence.

Third Stage:

Dependent Variable: FDI

Explanatory Variable	(18) Coeff. (S.E.)
Resource Dependence	8.565521* (3.423299)
Environmental Stringency	4.813497* (1.464037)
Openness to Trade	2.74678** (1.53188)
Human Capital	.53156 (.78764)
Market Size	1.21055* (.1328906)
Economic Development	.2655811 (.3046831)
Institutional Quality	.4252956 (.3623645)
Outlier Dummy	-2.040064* (.9011941)
Constant Term	-22.45748* (6.545127)
R-Squared	0.87
Dependent Variable: Resource Dependence	Coeff. (S.E.)
Resource Abundance	.0206914*** (.0139116)
Institutional Quality	-.0446333* (.0133828)
Historic Openness	.301041* (.0403255)
Constant Term	-.2017477** (.1118916)
R-Squared	0.63

First Stage:

Dependent Variable: Institutional Quality

(not shown: Similar to VI.D.3's First Stage Results)

*significant at the 5% level, **10%. *** 15%. **** 20% level.

Table 12 exhibits the IV-3SLS estimates for Regression 18. Indeed, resource export dependence has a positive correlation with natural capital abundance. In contrast, as already explained above, resource dependence has a significantly negative relationship with institutional quality. Overall, after treating resource dependence as endogenous, the results are almost similar to those observed in Regression 17. But, in the third stage, institutional quality's significance diminishes. Note, however, that

resource export dependence and environmental stringency are still significant at the 5% level. Therefore, the conclusions stated in Section VI.B.2 remain.

VII. Concluding Remarks

A. Summary

In explaining inward foreign direct investments, this paper attempted to use both of the arguments provided by the pollution haven hypothesis and the natural resource curse. The pollution haven hypothesis implies that foreign firms from developed countries are attracted by weak environmental policies in developing countries. Less developed economies are more inclined to sacrifice environmental quality for growth, and they might use less strict environmental standards as a tool to attract FDI. Meanwhile, the natural resource curse finds that countries that rely relatively more on resource exports tend to grow relatively slowly.

This study presents an original preliminary attempt to examine whether both environmental stringency and natural resource wealth have an impact on FDI location decision. From the regressions (OLS and IV) above, it can be concluded that aggregate environmental performance, institutional quality, and natural resources all have a significant impact on FDI location decisions. This finding is also strongly supported even when robustness checks (e.g. controlling for outliers) are conducted.

Overall, both the resource curse and pollution havens hypothesis do not hold in the context of FDI. That is, FDI appears to be attracted toward countries with abundant natural capital or high dependence on resource exports, and where environmental policy is relatively stronger. Finally, using an interaction term of institutions and resources, the relevance of institutions seems to matter for resource-export dependent countries, but not for natural resource capital.

B. Potential Extensions

Like previous studies, this paper has limitations too. Thus, future extensions are highly recommended. More rigorous robustness checks can be done. For example, a longer time frame and a larger sample of countries can be employed. Subject to data availability, the use of microeconomic (sector-specific) data is also strongly recommended. It is possible that the determinants of inward FDI in resource-intensive,

polluting industries will differ from the FDI determinants for other sectors. Finally, a more concrete investigation comparing the results for both point-source and diffuse natural resources is suggested.

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Appendix A: List of Countries

Argentina
Australia
Austria
Bangladesh
Bolivia
Brazil
Canada
China
Colombia
Cote d'Ivoire
Denmark
Dominican Republic
Egypt, Arab Rep.
Finland
France
Greece
Guatemala
Honduras
India
Indonesia
Ireland
Italy
Japan
Malaysia
Mexico
Morocco
Netherlands
New Zealand
Norway
Peru
Philippines
Senegal
South Africa
Sweden
Thailand
Trinidad and Tobago
Turkey
United Kingdom
United States
Zambia

Appendix B: Descriptive Statistics

This appendix tabulates the means and standard deviations of the variables used in this study. For a detailed definition of each variable, kindly refer to Section VI.A.2.

Variable	Mean	Std. Dev.	Source of Untransformed Data
			<i>(original levels, non-logged form)</i>
RESOURCE ABUNDANCE	8.616213	.9832487	www.cer.ethz.ch/resec/people/bchrista (B&B)
RESOURCE DEPENDENCE	.07325537	.1021005	B&B
INSTITUTIONAL QUALITY	.613	1.048587	B&B
HUMAN CAPITAL	.2208716	.1464548	http://soto.iae-csic.org/Data.htm
OPENNESS TO TRADE	.7289011	.3730577	World Bank's World Development Indicators
LATITUDE	.337945	.2040637	econ-www.mit.edu/faculty/acemoglu/data (AC)
FRENCH LEGAL ORIGIN DUMMY	.5	.5063697	AC
TRADE PROXY(EXOGENOUS)	.14557	.09990346	Tables in Frankel and Romer (1999)
FDI	22.31729	1.791342	WDI
MARKET SIZE	17.22993	1.523295	WDI
ECONOMIC DEVELOPMENT	8.418083	1.538368	WDI
ENVI. STRINGENCY (EPI INDEX)	4.265289	.1797492	http://www.yale.edu/epi/2006epi.htm
MINERAL DEPENDENCE	.0565956	.0988758	B&B
ENVI. STRINGENCY (SULFUR)	5.236517	1.732541	http://www.sterndavidi.com/datasite.html
MINERAL ABUNDANCE	6.410841	2.290752	B&B