ENVIRONMENTAL REGULATORY STRINGENCY, CORRUPTION, AND FDI: NEW EVIDENCE FROM A PANEL OF COUNTRIES

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ABSTRACT

Previous literatures on both studies of pollution haven and FDI-corruption nexus have produced inconclusive results. This study uses Generalized Method of Moments (GMM) to address potential endogeneity of independent variables and country-specific effects issues when assessing the relationship between foreign direct investment (FDI), stringency of environmental regulations and corruption. FDI inflows are found to be discouraged by stricter environmental regulations and high level of corruption will induce FDI. Surprisingly, we find new evidence that both effects are changed after each of them exceeds threshold levels. Countries have to pass the threshold levels in order to gain positive impact of both stricter regulations and low level of corruption.

Keywords: *FDI; pollution haven; corruption; developing countries; developed countries.*

1.0 INTRODUCTION

Developing and transition economies have increased their shares in global FDI inflows considerably within 1990 to 2012. There has been a persistent increase since 2001 and at the end of 2010, these nations have been accounted for over half of the global FDI inflows (see Figure 1). There are many key factors to describe this encouraging trend, among them are lower environmental regulations in these countries. Furthermore, in response to the downward global FDI trend since 2007, most countries have liberalized their investments regimes and are predicted to continue doing so (UNCTAD, 2010). These countries can be considered as “pollution haven” when large number of pollution-intensive industries entering these countries. Even though FDI inflows can raise level of pollution in developing countries, it can also be beneficial to these countries such as bringing cleaner or environmental friendly technologies from developed countries (see Atici (2012) for instance).

There is a common view that developing countries try to lower their environmental regulations in order to be competitive in the world markets and to be attractive prospect for FDI. Countries with high per capita income tend to have stricter environmental policy, and conversely countries with low per capita income tend to have lenient environmental policy, shown by high correlation between both indicators (Eliste & Fredriksson, 2001). Baumol and Oates (1988) claimed that under trade between two countries, countries with low environmental standards will specialize in polluting industries. Capital seems to be attracted to lower regulations countries rather than those with higher standards. Leidy and Hoekman (1994) found that polluting investors favour inefficient environmental policy instruments due to lower trade hindrances. Within 1970s and 1980s many polluting firms had allocated their capital flows to lower income countries with lenient environmental regulations (Low & Yeates, 1992). Since lax environmental regulations are always associated with developing countries, Birdsall and Wheeler (1992) found that proportion of pollution intensive sectors in developing countries increased as OECD environmental regulations were strengthened. Less developed countries were also attracted to poor environmental standards since these countries often employ outdated, imported technologies (Blackman, 2006).

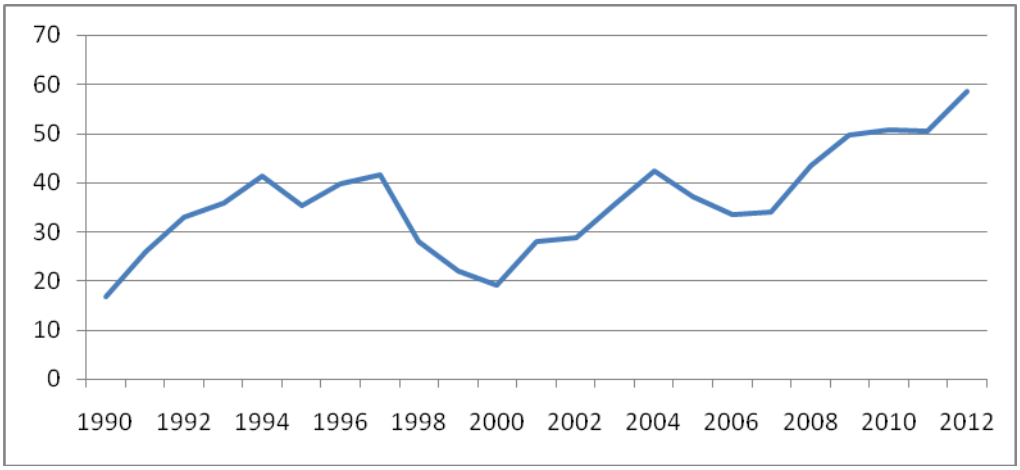

Figure 1: Percentage shares of developing and transition economies in global FDI inflows 1990–2012

Pollution haven effect did not necessarily occur only in developing countries as it is also occurred in developed countries. Mulatu et al. (2010) found that an increase of host's environmental regulatory laxity in Europe does lead most polluting industry to locate in that country. Kalamova and Johnstone (2011) also found empirical evidence that the pollution haven occurs in OECD countries.

Corruption can influence inward FDI, confirmed by earlier studies. Prior research has suggested practicing corruption to bypass bureaucratic procedures in order to induce

FDI (Leff, 1964). Public officials could accelerate economic activities (Leys, 1965) and earn own additional income via bribery. Low income among officials could possibly lead them to take bribe (Leys, 1965; Bailey, 1966). However, corruption may bring undesirable consequences such as negative economic growth in developed and developing countries via unproductive rent seeking activities (Krueger, 1974), lower productive investment (Mauro, 1995) and investment and trade policy (Pellegrini & Gerlagh, 2004). Additionally, corruption reduces government revenues (Bird et al, 2008), aggravates pollution and income per capita (Welsch, 2004). Past studies suggested that the role of corruption on FDI is mixed, either corruption act as a "grabbing hand" which increases the expenditures of carrying out economic activities or "helping hand" which assist the entry process of FDI or no influence.

Furthermore, corruption is among the major causes of environmental degradation in developing countries (Damania, 2002). These countries have to find the right balance between industrialisation and environmental regulations. The purpose of this paper is to verify the existence of pollution haven effect in the presence of corruption across countries. This paper may help to reveal answers for mixed findings of pollution haven and FDI-corruption nexus. In particular, we provide empirical evidence to show how the effects of environmental regulations on FDI are changed.

Race to the bottom competition has become the concern for environmentalists as countries might increase their comparative advantage by adopting lower environmental standards to attract foreign investment. However, lax environmental regulations in host countries can lead to environmental degradation. Corruption practice can hamper the strength of legislation in protecting host's environment. Corrupted officials or entrusted authority might misuse their power for their own interest in the enforcement of environmental regulations (Damania, 2002). This study may assist government at national scale in formulating strategic environmental regulations in the presence of varying level of corruption.

2.0 LITERATURE REVIEW

The effect of heterogenous environmental regulations on trade flows or FDI has reached into three different conclusions, whether it is negative, positive or no effect. Here we include the several causes of the mixed findings. This diverse can be described in terms of advanced technological production possessed by investors. Eskeland and Harrison (2003) found that FDI enterprises from polluting firms experienced more efficient energy use than their domestic competitors in host developing countries. Dean et al. (2009) also reached the similar conclusion showing that Multinational Enterprises and developed countries investors are found to be not affected by higher regulatory requirements in China.

Kheder and Zugravu (2012) support the finding of Dam and Scholtens (2008) who imply that poor environmental regulations in host countries hamper allocation of multinational firms with good corporate social responsibility. Behaviour among investors on the awareness towards environment would encourage investors to innovate green technology for their production instead of seeking for pollution haven (Costantini & Crespi, 2008). Good quality of regulatory framework in terms of its certainty and transparency in host countries attracted inward Japanese dirty FDI greater than the level of environmental regulatory measures (Kirkpatrick & Shimamoto, 2008).

Ederington et al. (2005), Kellenberg (2009), and Wagner and Timmins (2009), have demonstrated that footloose or geographically mobile industries are more negatively affected by environmental policy rather than the dirty sectors. A strand of literature outlines the importance of estimation method or procedure. Smarzynska and Wei (2004) emphasized the essential of precise dependent variable measure and good proxies for stringency in order to reduce measurement-error bias. Levinson and Taylor (2008) suggest that most existing literatures have failed to account unobserved heterogeneity, unobserved foreign environmental regulations, and aggregation bias measurements of the relationship between both trade and pollution abatement costs. Failure to control agglomeration externalities does also mask the pollution haven effect (Wagner & Timmins, 2009).

Cole et al. (2006) had made first attempt in examining if FDI influence environmental policy. They found that FDI will promote environmental policy to be more stringent (lenient) when the level of corruption of policymakers in host country is high (low). Their evidences gave support to previous literatures that countries necessitate to reduce their level of corruption in order to induce FDI and improve environmental quality.

Recently, Barassi and Zhou (2012) used parametric and non-parametric method to reassess the mixed findings of the relationship between FDI and corruption. They stressed that the employment of parametric method in the existing literatures may have brought misleading results since parametric method treats homogeneous when figuring the effect of corruption on FDI across all the quantiles of FDI distribution. Non-parametric method employed unmasked the heterogeneity of the relationship between FDI and corruption at different quantiles of FDI stock. They found robust evidence that host countries with corruption level lower (higher) than the average of Corruption Perception Index would attract FDI stock higher (lower) than other host countries of the same percentile of the FDI stock. However, Barassi and Zhou (2012) and most existing studies of FDI-corruption ignore the presence of environmental regulations. Corruption might be insignificant when explaining foreign investment in the presence of environmental regulations (Fredriksson et al., 2003; Kellenberg, 2009) and corruption does not affect FDI inflows independently (Mudambi et al, 2013).

3.0 METHODOLOGY

3.1 Model Specification

We estimate the impact of environmental stringency and corruption on FDI inflow at the country level. The model specification is as follows:

$$FDI_{i,t} = \alpha FDI_{i,t-1} + \beta_1 STRICT_{it} + \beta_2 HONESTY_{it} + \beta_3 STRICT_{it} \times HONESTY_{it} + \lambda X'_{it} + \eta_i + \varepsilon_{it} \quad (1)$$

where subscripts i and t denote country and year respectively, FDI INFLOW is FDI inflow of host country in terms of billions of dollars, STRICT is stringency of environmental regulations, HONESTY is level of corruption, and the rest is controlled variables hypothesized to influence FDI inflows: openness, inflation, GDP, GDP growth, total population, financial development and infrastructure. Some controlled variables represent natural logarithm. Country-specific effect is represented by η and β_1, β_2, β_3, λ, α will be estimated by the GMM estimator, and ε is the error term. Lagged dependent variable is taken into account as data on FDI inflows often exhibit persistent trend. We conjecture that profit maximizing MNEs or investors respond homogeneously towards heterogeneous of environmental regulations. Therefore, sign for β_1 is supposed to be negative which means relatively stringent environmental regulations deter FDI whilst lax environmental regulations induce FDI. In other words, pollution haven effect can be validated in this finding. Based on the Egger and Winner (2005), we could confirm that the expected sign of β_2 is negative which means corruption is a stimulus for FDI. Based on the existing literatures, the expected sign for β_3 is positive, indicating good quality of regulations encouraging inward FDI. The sign of the interaction term would contribute in the on-going debate particularly in the study of FDI and corruption.

3.2 Dynamic Panel GMM Estimation

Potential endogeneity of independent variables, inclusion of the lagged dependent variable and the presence of the country-specific effects have made impossible for us to estimate using panel estimation model such as pooled OLS, fixed and random effect respectively. Problems aforementioned would bring Nickel (1981) bias if we use the panel data estimation. Thus, generalized method of moment (GMM) proposed by Arellano and Bond (1991) have the capability to combat these problems. GMM method can tackle the country-specific effects by taking the first differences of equation (1) but however, we suffer missing values of some explanatory variables and will subsequently bring difficulties in the transformed data (Roodman, 2009). Therefore, we use forward orthogonal deviation transformation procedure proposed by Arellano and Bover (1995) to wipe out the country-specific effects. However, new bias appears resulted from forward orthogonal deviation, which is correlation between lagged dependent variable and the

error terms. Arellano and Bond (1991) and Arellano and Bover (1995) suggested that the lagged levels, lagged two or more periods to be used as instruments for the differenced lagged dependent variables and other endogenous variables. This method can be referred to either one-step or two-step difference GMM.

Alonso-Borrego and Arellano (1999) and Blundell and Bond (1998) showed that if the lagged dependent variable and independent variables follow a random walk or persistent over time, the lagged levels of these variables are poor instruments for the regression equation in differences. Arellano and Bover (1995) suggested GMM system estimator in order to reduce biases and imprecision produced by difference estimator by estimating the difference equation and the level equation as a system. In the system estimation, the instruments for the regression in levels are the lagged first-differenced variables. We adopt the two-step system GMM in this study since two-step GMM is more favoured than the one-step GMM in estimating the coefficient with lower bias and standard errors (Windmeijer, 2005).

The unbiased, consistency and efficiency of the GMM estimator is contingent on three specification tests namely the Hansen or Sargan test for over-identifying restrictions, the serial correlation test for disturbances, and the difference in Hansen test for extra moment's conditions (Arellano & Bond, 1991; Arellano & Bover, 1995; and Blundell & Bond, 1998). The Hansen or Sargan test is based on the overall validity of the instruments by analysing the sample analogue of the moment conditions used in the estimation process. Failure to reject the null hypothesis of the Hansen or Sargan test would indicate that the instruments employed are valid and the system GMM estimation are well specified. Serial correlation test is conducted by do not reject the null hypothesis of the absence of the first order serial correlation, AR(1) and/or (just in case when the null hypothesis is rejected) do not reject the absence of the second order serial correlation, AR(2). Failure to reject the null hypotheses of difference in Hansen test would give support to the validity of additional moment conditions. These three specification tests are considered in this paper.

3.3 Data Source

We test the model using unbalanced panel data from a mix of 110 developed and developing countries for the period of 2006 to 2010. FDI Inflow data is expressed as FDI inflows billions of dollars and are available in the UNCTAD. Environmental Performance Index (EPI) obtained from http://epi.yale.edu/ is used as a proxy for stringency of environmental regulations. We check the robustness of our result by substituting EPI data with data from the World Economic Forum's (WEF) Executive Opinion Survey. The WEF's stringency of environmental regulation index has been widely used to measure stringency of environmental regulations in recent studies (e.g. Kalamova & Johnstone, 2011). Corruption perception index (CPI) was obtained from Transparency International to

measure the level of corruption in host countries. The index scaled from 0 to 10 where the higher score indicates higher level of honesty. Hence, in this paper, negative coefficient for HONESTY means high level of corruption induces FDI. The remaining controlled variables were obtained from the World Development Indicators (WDI). Table of descriptive statistics are included in Appendix A.

4.0 RESULTS

Initially we report the estimation results of the baseline model and we subsequently report results for robustness check after considering another alternative variable to measure the stringency of environmental regulations.

Table 1: Two-step system GMM estimation on FDI inflows, regulatory stringency and corruption

Dependent variable: FDI inflows					
Independent variables	(1)	(2)	(3)	(4)	(5)
FDI INFLOW (-1)	0.511***	0.327***	0.300***	0.300***	0 .301***
STRICT	**-0.683*****	**-0.997*****	**-0.955*****	**-0.951*****	**-0.937*****
HONESTY	**-5.501*****	**-9.280*****	**-8.585*****	**-8.055*****	**-8.082*****
STRICT*HONESTY	**0.132*****	**0.185*****	**0.167*****	**0.162*****	**0.163*****
GDP GROWTH	0.430***	0.438***	0.353***	0.401***	0.406***
INFLATION	-0.136	0.007	0.026	0.030*	-
FINANCIAL	-	0.024***	0.019**	0.016*	0.013*
LnGDP	-	4.668***	5.673***	4.572***	4.479***
LnPOPULATION	-	-	0.676*	1.607***	1.705***
LnOPENNESS	-	-	3.636***	3.273***	3.425***
LnINFRASTRUCTURE	-	-	-	1.385***	1.367***
CONSTANT	31.811***	31.056***	3.843	-3.240	-4.771
AR(1): p-value	0.033	0.038	0.042	0.040	0.040
AR(2): p-value	0.190	0.145	0.147	0.144	0.144
Hansen test: p-value	0.358	0.233	0.186	0.272	0.309
Number of observations	417	400	400	400	400
Number of countries	108	107	107	107	107

*** significant at 1%; ** significant at 5%; * significant at 10%. All p-value of the difference in Hansen tests of exogeneity of instruments subsets are not rejected at the 5% significance level. Some countries are dropped in the estimations due to inadequacy in lagged instruments.

Based on the three specification tests conducted, the GMM estimators are said to be unbiased, consistent and efficient. The sign for environmental regulatory stringency support pollution haven effect in which stringent environmental regulations is found to discourage allocation of FDI. They suggest that a point increase in stringency is related to the decrease in FDI inflows by roughly 6.83 to 9.97 US billions of dollars. In line with Kalamova and Johnstone (2011), pollution haven occurred in developed and less developed countries. The impact of honesty in host countries on the level of FDI inflow is significant and negative. Our results are consistent with Egger and Winner (2005) in which corruption can be "helping hand" for FDI inflow.

Surprisingly, the interaction term (STRICT*HONESTY) effect is inversed which means that both the negative effects aforementioned are changed at certain levels, holding all other factors constant. Both threshold points reveal the answer for on-going debate of the impact of FDI towards both environmental regulations and corruption. The threshold level for stringency of environmental can be estimated as $-\beta_2/\beta_3$. Based on the estimation (4), the outcome implies that the effect of environmental regulatory stringency on FDI is negative (positive) when the score for stringency is lower (higher) than 49.72 (= - (- 8.055) / 0.162).

While the threshold level for corruption or honesty can be estimated as $-\beta_1/\beta_3$. Based on the estimation (4), the outcome implies that the effect of honesty on FDI is negative (positive) when the score for honesty is lower (higher) than 5.87 (= - (- 0.951) / 0.162). This corruption's threshold value seemed somewhat complements the findings of Barassi and Zhou (2012) in which less corrupt country would encourage more FDI stock than more corrupt country, if they share the same percentile in the FDI stock cumulative distribution. The positive coefficients of the interaction term are consistent with Kirkpatrick and Shimamoto (2008) and implies that transparent, consistent, and accountable in regulatory environment can provide perception of a safer investment climate and subsequently gained investor's confidence towards host countries, hence encourage FDI. Our results contradict to the findings of Kheder and Zugravu (2012) who declared that investors favour countries with relatively weak environmental regulations regardless of the corruption level of host countries.

Table 2: Robustness check with WEF's stringency of environmental regulation as alternative variable

Dependent variable: FDI inflows					
Independent variables	(6)	(7)	(8)	(9)	(10)
FDI INFLOW (-1)	0.207***	0.212***	0.205***	0.217***	0.224***
STRICT	**-8.752*****	**-8.596*****	**-8.958*****	**-7.546*****	**-8.128*****
HONESTY	**-4.761***	**-4.454***	**-5.366****	**-5.335****	**-3.704***
STRICT*HONESTY	**1.460*****	**1.416*****	**1.563*****	**1.263*****	**1.282*****
GDP GROWTH	0.344***	0.344***	0.296***	0.370***	0.399***
INFLATION	-0.006	-	-0.012	0.023	0.022
FINANCIAL	0.060**	0.063**	0.057**	0.056*	0.075***
LnGDP	2.096*	1.603*	2.837***	5.309***	1.101
LnPOPULATION	3.830***	4.220***	3.491***	-	3.690***
LnOPENNESS	3.312**	3.100**	4.360***	0.459	-
LnINFRASTRUCTURE	1.385	1.300*	-	0.154	1.429*
CONSTANT	-32.575***	-35.291**	-32.873**	5.867	-18.522
AR(1): p-value	0.051	0.051	0.055	0.053	0.048
Hansen test: p-value	0.191	0.201	0.195	0.210	0.218
Number of observations	285	285	285	285	285
Number of countries	100	100	100	100	100

*** significant at 1%; ** significant at 5%; * significant at 10%. All p-value of the difference in Hansen tests of exogeneity of instruments subsets are not rejected at the 10% significance level. Some countries or cross sections are dropped in the estimations due to inadequacy in lagged instruments.

Table 2 shows that the sign for all the coefficients in bold are significant and same as the previous estimation. This strongly implies that pollution haven occurs in which stricter environmental regulations impeded FDI whilst lenient environmental regulations induced FDI. Helping hand is also supported in the result since low level of corruption will impede FDI while high level of corruption in host countries will induce FDI. Interestingly, significant and positive coefficient of the interaction between stringency and corruption provide robust evidence and these consistent outcomes strongly suggest both the effects of stringency and corruption toward FDI is contingent on the threshold levels.

5.0 CONCLUSION AND POLICY RECOMMENDATIONS

The purpose of this study is to empirically assess the role of corruption and stringency of environmental regulations on FDI inflows in 110 developed and developing countries within period of 2006 to 2010. GMM estimation is employed to control for potential endogeneity of independent variables and country specific effect. We find that differences in environmental regulatory stringency in host countries are a significant determinant of FDI inflows but the effect is conditional on the level of corruption. Robust evidence is found for the effect environmental regulatory stringency on FDI is negative (positive) when the level of corruption is higher (lower).

Countries with stringent environmental regulations such as Czech Republic, Slovak Republic, Italy and Greece should improve their level of corruption. An improvement in corruption can speed up the development process (Myrdal, 1968) and attract the most efficient producers to invest (Shleifer & Vishny, 1993) and subsequently improve its environmental performance. For developing countries, since FDI brings advanced technologies, their corruption level among public officials need to be reduced and environmental policy should be enhanced. Political stability in these countries play role in this part, as previous studies claimed that level of corruption affect stringency of environmental regulations only when there is instability in political affairs. Transparent, stable and accountable environmental regulation is dependence on the neutrality of a host government (Parker, 1999). We stress the importance of institutional development in these countries since it will lead the regulatory system of environmental protection become more transparent, consistent, and rigorous. All countries are not necessary to engage in the race to the bottom competition.

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APPENDIX

A. List of Countries

Angola	Finland	Luxembourg	Senegal
Argentina	France	Macedonia	Serbia
Armenia	Gabon	Malaysia	Singapore
Australia	Georgia	Malta	Slovak Republic
Austria	Germany	Mexico	Slovenia
Azerbaijan	Ghana	Moldova	South Africa
Belarus	Greece	Mongolia	Spain
Belgium	Guatemala	Morocco	Sri Lanka
Bolivia	Haiti	Mozambique	Sudan
Botswana	Honduras	Namibia	Sweden
Brazil	Hungary	Nepal	Switzerland
Bulgaria	Iceland	Netherlands	Syria
Cameroon	India	New Zealand	Tajikistan
Canada	Indonesia	Nicaragua	Tanzania
China	Iran	Nigeria	Thailand
Colombia	Ireland	Norway	Togo
Costa Rica	Italy	Oman	Trinidad and Tobago
Cote d'Ivoire	Jamaica	Pakistan	Tunisia
Croatia	Japan	Panama	Turkey
Cyprus	Jordan	Paraguay	Ukraine
Czech Republic	Kazakhstan	Peru	United Arab Emirates
Denmark	Kenya	Philippines	United Kingdom
Ecuador	Korea, Rep.	Poland	Uruguay
Egypt	Kuwait	Portugal	Vietnam
El Salvador	Kyrgyz Republic	Qatar	Yemen
Eritrea	Latvia	Romania	Zambia
Estonia	Libya	Russia	
Ethiopia	Lithuania	Saudi Arabia	

B. Descriptive Statistics

Variable	Mean	Std. Dev.	Min.	Max.
FDI inflows (bill)	10.46	22.66	-28.26	196.39
Environmental Performance Index (EPI)	53.47	9.58	32.54	77.99
WEF's stringency of environmental regulation	4.16	1.10	2.00	6.70
Corruption Perception Index (CPI)	4.44	2.23	1.40	9.60
GDP growth	3.89	4.99	-17.95	34.50
Inflation, consumer prices	6.11	5.16	-4.86	44.39
Private sector credit (% of GDP)	96.89	683.39	6.03	15788.26
GDP (current US$)	377.07	814.76	1.21	5930.53
Total population (per 1000 people)	50446.36	168726.40	214.65	1337705.00
Openness ((Export+Import)/GDP)	92.42	51.45	22.12	444.10
Telephone lines (per 100 people)	22.96	18.13	0.29	67.24