Int. Journal of Economics and Management 1(2): 245 – 261 (2007) ISSN 1823 - 836X

Foreign Direct Investment and the Pollution in Five ASEAN Nations

YASMINE MERICAN[a]*, ZULKORNAIN YUSOP[b], ZALEHA MOHD. NOOR[c] AND LAW SIONG HOOK[d]
[a,b,c,d]*Department of Economics, Faculty of Economics and Management, Universiti Putra Malaysia.*

ABSTRACT

We investigated the impact of FDI on pollution for Malaysia, Thailand, Indonesia, Singapore, and the Philippines- significant FDI recipients within the developing world in the last three decades- and the findings invite further questions. Our time-series analyses, employing the Autoregressive Distributive Lag (ARDL) technique suggest that FDI adds to pollution in Malaysia, Thailand, and the Philippines but not in Indonesia where FDI is inversely related to pollution, and Singapore where it proved insignificant.

Keywords: Pollution, Foreign Direct Investment, Neo-liberalism, ASEAN, Bounds Test.

BACKGROUND

Amongst nations in the developing world, the ASEAN-5 nations-Malaysia, Thailand, Indonesia, Singapore, and the Philippines- have had a significant share of FDI inflows in the last three decades. Hence, it warrants that a study be undertaken to examine the impact of FDI on the physical environment of these nations.

Neo-liberal proponents argue that FDI is positively good for the environment (Zarsky, 1999 and Goldenman, 1998). Given the lack of local technologies and regulatory capability, FDI is the best way to diffuse best practice production

* Corresponding author. E-mail: yasmine96@gmail.com

techniques. However, FDI critics postulate that the neo-liberal FDI has differential environmental regulations influence firm (or industry) level location decisions or what is known as the "pollution haven" hypothesis or PHP.

Eskeland and Harrison (1997) using a mix of cross-sectional and panel data for four developing countries (Côte d'Ivoire, Mexico, Morocco, and Venezuela) and find no significant correlation between environmental regulation in industrialized countries and foreign investment in developing countries. Neither could Eskeland and Harrison find evidence that foreign investors are concentrated in "dirty industries" with the exception of Morocco where there is a heavy concentration of foreign investors in the cement industries. They conclude that in both industrial and less developed countries, policy makers can pursue pollution control policies on pollution itself, rather than on investment or particular investors.

Kolstad and Xing (2002) test the impact of lax environmental regulations on capital movement of polluting industries. The data used by Kolstad and Xing are cross-sectional data that cover 22 countries including seven developing countries and 15 developed countries from 1985 through 1990. They conclude that for highly polluting industries, more lax environmental regulations do encourage FDI inflows into a host country. Their conclusion is further strengthened by the failure of to find a similar effect in the "less" polluting industries such as electrical and non-electrical machinery, transportation equipment, and food products.

Talukdar and Meisner (2001) look for a systematic relationship between CO2 emissions per capita, their proxy for the environment, with various institutional and structural dimensions such as the scope of financial market, industrial sector composition, and the level of FDI. The results show that the higher the degree of private sector involvement in a developing economy, the lower is its environmental degradation. A well-functioning domestic capital market and the increased participation by developed economies in its private sector development further reduce environmental degradation. The negative value for FDI suggests that foreign direct investment in an economy is likely to have a positive impact on the environment. Hence, this finding supports the argument that foreign direct investments in developing countries are more likely to act as "conduits" for advanced, and cleaner, environmental technologies.

The paper is organized as follows. Section 2 provides the pollution and FDI trend in ASEAN-5 nations. Section 3 explains the empirical model, econometric technique and the data employed in the analysis. Section 4 reports and discuses the empirical results. Finally, Section 5 summarizes and concludes.

POLLUTION AND FDI TREND IN ASEAN-5

Table 1, illustrates that carbon dioxide emissions are on the rise in all the five ASEAN nations. This trend is prevalent in all five nations from 1970 through 2001 and expected to persist in the future if no concerted efforts are made to improve the prevailing situation.

Table 1 ASEAN-5 CO2 Emissions (Metric tons per capita) and FDI (as in % of GDP)

Nation\Year	1970	1975	1980	1985	1990	1995	2000	2001
Malaysia								
CO2	1.33	1.57	2.03	2.29	3.04	5.77	5.9	6
FDI	0.09	0.35	0.9	0.7	2.61	5.82	3.79	0.55
Thailand								
CO2	0.43	0.59	0.86	0.95	1.72	3.1	3.3	3.5
FDI	0.04	0.09	0.19	0.16	2.5	2.07	3.35	3.81
Indonesia								
CO2	0.28	0.4	0.64	0.75	0.93	1.21	1.1	1.2
FDI	0.08	0.48	0.18	0.31	1.1	4.35	–4.55	–2.98
Singapore								
CO2	8.77	10.27	12.5	11.1	13.8	18.1	14.07	14.47
FDI	0.09	0.3	1.2	1.05	5.56	11.6	17.22	15.03
Philippines								
CO2	0.67	0.76	0.76	0.54	0.73	0.92	1.03	0.99
FDI	–0.001	0.11	–0.11	0.01	0.55	1.57	1.3	0.98

Source: World Bank World Development Indicators (2003) and United Nations Statistics Division (UNSD) (2005).

Not only is carbon dioxide increasing but its increasing trend parallels the increasing FDI trend in all the ASEAN-5 nations. As such, it warrants an examination of the relationship between FDI and the greenhouse gas. This is even more significant since the reduction of carbon dioxide emissions metric tons per capita is an indicator adopted by the United Nations for its Millennium Development Goals (MDGs) to measure environmental sustainability. The United Nations advocates the integration of the principles of sustainable development into country policies and program to reverse the loss of environmental resources. The establishment and ratification of Kyoto Protocol as law in 2005 (Greenpeace, 2005) to limit emissions of greenhouse gases lends further significance to this study since the ASEAN-5 nations are expected to be given specific targets to reduce CO2 emissions eventually.

EMPIRICAL MODEL

In order to test the impact of FDI on pollution in five ASEAN nations, we adopt the modified version of Talukdar and Meisner (2001)'s empirical model given the study's small sample size.

$$E_t = \alpha + \beta_1 GNIPC_t + \beta_2 MV_t + \beta_3 FDI_t + \varepsilon_t \qquad (1)$$

where E_t is CO2 metric ton per capita, $GNIPC_t$ is Gross National Income per capita in 1995 prices (US$ in million), MV_t is manufacturing value-added (% of GDP) and FDI_t is nominal gross inflows of foreign direct investment (% of GDP).

Based on Modernization/Neo-classical/ Neo-liberal Theories, the following is expected:

$$\beta_1, \beta_2 > 0 \quad \beta_3 < 0$$

Based on critics of FDI, the following is expected:

$$\beta_1, \beta_2 > 0 \quad \beta_3 > 0$$

The model will determine whether a long run relationship exists amongst all the variables. To investigate the impact of income (GNI per capita), structural change (value-added manufacturing variable), and capital (foreign direct investment) on pollution, the long-run elasticities of the variables will be estimated.

Variables and Data

This study adopts Taludkar and Meisner (2001)'s dependent variable of CO2 metric ton per capita. This variable is in tandem with the millennium development goal 7, target 28, to reduce the greenhouse gas. CO2 data are sourced from the World Bank Development Indicators (WDI) 2003 CD-ROM which in turn derived its data from the Carbon Dioxide Information Analysis Center at the Oak Ridge National Laboratory (ORNL), USA. The data include emissions from aggregate fossil fuel consumption and cement manufacture. Although this dataset excludes emissions from activities such as the burning of fuel wood and dung in the informal sector of a developing country, its time-series data for CO2 are considered to be consistent and reasonably reliable by many researchers given the absence of other reliable sources [Moomav and Unruh (2005) in Taludkar and Meisner (2001)].[1]

i. Scale of the economy

Output or income levels by GNI per capita are proxied in accordance with United Nations and the World Bank's new measurement of national income formerly known as GNP per capita. Many of the studies surveyed were unanimous in identifying income per capita as a major predictor of pollution levels (Taludkar and Meisner 2001, Bimonte 2002, Cole 2004). None of the study on the determinants of pollution levels omitted income as an explanatory variable because most of the expected environmental effects of FDI included the scale effect or simple the expansion of economic output (Organisation for Economic Co-operation and Development (OECD) 2002). GNI per capita data are sourced from WDI 2003.

The sign of income is postulated to be positive based on previous studies using linear models (Rock, 1996, Friedl and Getzner, 2003, Cole, 2004). This is because in the first period of development, a positive sign is expected when emissions metric ton per capita would increase with income (GNI per capita). Thus, the null hypothesis of total output per person increases pollution will also be tested. Given that none of the selected ASEAN nations has increased its 2001 GNI per capita to the level of the squared value of its 1970 GNI per capita value, it diminishes the need to adopt a quadratic version of the model by adding a squared GNI per capita as an added explanatory variable. Furthermore, some environments would have reached the point of no return if society were to solely rely on income to increase by leaps and bounds before seeing a reduction in pollutants. According to Dasgupta, Laplante, Wang, and Wheeler (2002) there appear to be three main reasons why wealthier countries regulate pollution more stringently. First, pollution damage receives greater attention when a nation has attained basic levels in health and education through investment. Second, higher-income societies normally have

[1]See Boden, Marland, and Andres (2005) for the computational details of the CO2 dataset.

more technical personnel and budgets for monitoring enforcement activities. Third, higher income and education empower local communities to enforce higher environmental standards, regardless of the national government's stance (Dasgupta and Wheeler (1997), Pargal and Wheeler (1996), Dean, (1999) in Dasgupta *et. al.* (2002)].

ii. Structural Change

The value-added measure of manufacturing in terms of percentage GDP reflects structural change in the ASEAN-5 economy. In this way, conclusions on the impact of structural change on CO2 emission levels per capita income can be drawn. Manufacturing-value added is expected to have a positive sign since industrialization is seen by many scientists as a major contributor to the high CO2 levels in the world today. Hence, the null hypothesis that manufacturing increases pollution will be tested. Manufacturing-value added data are also sourced from WDI 2003.

iii. Capital

FDI will be used to test its impact on pollution. Taludkar and Meisner (2001) and Letchumanan and Kodama (2000) postulate that lax environmental standards and enforcement in developing countries intensify pollution further by attracting investment in pollution-intensive industries from developed countries, creating a comparative advantage for nations with lower environmental standards as previously discussed. However, FDI critics argue that FDI will result in an improved environment since it will allow the host FDI nations to have access to cleaner technology and this will compel pre-existing industries to "clean-up" their production processes. Hence, we will test the null hypothesis that FDI increases pollution. FDI data are obtained from United Nations Conference on Trade and Development (UNCTAD) online database. GDP data are also sourced from WDI 2003.

Model Estimation: Autoregressive Modeling Approach

We chose the Autoregressive modeling approach by Pesaran *et. al.* (2001) over the conventional maximum likelihood based on Johansen (1991) and Johansen and Juselius (1990) approach, used for the multivariate case, for several reasons. First, the ARDL approach which requires the dependent variable or regressor to be I(1) is advantageous because the explanatory variables or regressands can either be purely I(0) or I(1) or a mix of both**.** The Johansen (1991) and Johansen and Juselius (1990) approach requires that the variables in the system be of equal order of integration. Second, ARDL takes sufficient numbers of lags to capture the data generating process in a general-to-specific modeling framework (Shrestha, 2005). Third, the ARDL Error Correction Model integrates the short-run dynamics with the long-run equilibrium without losing long-run information. Fourth, this approach can be applied to studies with a small sample size such as this study. It is widely understood that the Engle & Granger (1987) and Johansen (1988, 1995) methods of cointegration are not reliable for small sample sizes. Pattchis (1999), Tang (2001, 2002), Tang and Nair (2002) and Narayan and Smith (2005) all used sample sizes smaller than 30 observations in their respective studies.

Bounds Testing Approach

Following the modeling approach developed in Pesaran *et al*. (2001), we start from the maintained assumption that the time series properties of the variables included in the Equation (1) can be well approximately by a log-linear VAR(*p*) model:

$$z_t = \mu + \sum_{i=1}^{p} \beta_i z_{t-i} + \varepsilon_t \tag{2}$$

where z_t is the vector of both x_t and y_t, where y_t is the dependent variable defined as E, and x_t = [$GNIPC_t$, MV_t, FDI_t]' is the vector matrix which represents a set of explanatory variables. μ = [μ_y, μ_x]', t is a time or trend variable, b_i is a matrix of VAR parameters for lag *i*. According to Pesaran *et al*. (2001), y_t must be I(1) variable, but the regressor x_t can be either I(0) or I(1).

We further developed the model as follows:

$$\Delta z_t = \mu + \alpha t + \lambda z_{t-1} + \sum_{i=1}^{p-1} \gamma_i \Delta y_{t-i} + \sum_{i=0}^{p-1} \varphi_i \Delta x_{t-i} + \varepsilon_t \tag{3}$$

where Δ is first-difference operator. We then partitioned the long-run multiplier matrix l as:

$$\lambda\begin{bmatrix}\lambda_{yy} & \lambda_{yx}\\ \lambda_{xy} & \lambda_{xx}\end{bmatrix}$$

The diagonal elements of the matrix are unrestricted, so the selected series can be either I(0) or I(1). If $\lambda_{yy} = 0$, the y is I(1). In contrast, if $\lambda_{yy} < 0$, the y is I(0).

The VECM produces described above are important in the testing of at most one cointegrating vector between dependent variable y_t and a set of regressors x_t. In order to derive our preferred model, we followed the assumptions made by Pesaran *et al*. (2001) in Case III, that is, unrestricted intercepts and no trends. After imposing the restrictions $\lambda_{xy} = 0$, $\mu \neq 0$, and $\alpha = 0$, the pollution specification can be stated as the following unrestricted error-correction model (UECM):

$$\begin{aligned}\Delta \ln E_t &= \beta_0 + \beta_1 \ln E_{t-1} + \beta_2 \ln GNIPC_{t-1} + \beta_3 MV_{t-1} + \beta_4 \ln FDI_{t-1}\\ &+\beta_5 \sum_{i=1}^{p} \Delta \ln E_{t-i} + \beta_6 \sum_{i=0}^{q} \Delta \ln GNIPC_{t-i} + \beta_7 \sum_{i=0}^{r} \Delta \ln MV_{t-1}\\ &+\beta_8 \sum_{i=0}^{s} \Delta \ln FDI_{t-i} + u_t \qquad (4)\end{aligned}$$

where Δ is the first-difference operator, u_t is a white-noise disturbance term. Equation (4) also can be viewed as an ARDL of order (p, q, r, s). The structural lags are determined by using minimum Akaike's information criteria (AIC). In this case, the long-run elasticity can be derived by dividing each of the one lagged explanatory variable by the coefficient of the one lagged dependent variable.

After obtaining of Equation (4), the Wald test (F-statistic) was computed to discern the long-run relationship between the concerned variables. The Wald test can be conducted by imposing restrictions on the estimated long-run coefficients of *CO2*, *GNIPC*, *MV* and *FDI*. The null and alternative hypotheses are as follows:

H_0 : $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ (no long-run relationship)
H_A: $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$ (a long-run relationship exists)

The computed F-statistic value will be compared with the critical values tabulated in Table CI (III) of Pesaran *et al*. (2001). If the computed F-statistic is smaller than the lower bound value, then the null hypothesis is not rejected and we conclude that there is no long-run relationship between CO2 and its determinants. Conversely, if the computed F-statistic is greater than the upper bound value, then CO2 and its determinants share a long-run level relationship. On the other hand, if the computed F-statistic falls within these bounds, inference would be inconclusive.

EMPIRICAL RESULTS

The Bounds Test was used on all models to investigate the presence of a long run relationship among the variables specified for each country. In table 2, the results of Pesaran *et al.* (2001) bounds test obviously demonstrate that the null hypothesis $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ against its alternative, $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$ is easily rejected at 1 % confidence level. The computed F-statistic for Malaysia 7.06 is greater than the upper critical bound of 5.06 and hence the null hypothesis of no cointegration is rejected at the 1% confidence level. Likewise the computed F-statistics for Thailand of 5.75, Indonesia of 6.05, Singapore of 6.15, and the Philippines of 11.72 were all rejected at upper bound critical value. Therefore, based on the test results, it was concluded that there exists a steady state long-run relationship amongst pollution, GNI per capita, manufacturing value added, and foreign direct

Table 2 Bounds Test for Cointegration Test

Null Hypothesis: No Cointegration Computed F-statistic (Wald Test):			
Malaysia	: 7.06		
Thailand	: 5.75		
Indonesia	: 6.05		
Singapore	: 6.15		
Philippines	: 11.72		
		Critical Value	
		Lower	Upper
1%	significance level	3.74	5.06
5%	significance level	2.86	4.01
10%	significance level	2.45	3.52
Decision: Reject or Accept null hypothesis at 5 % significance level			

Note: The critical value is taken from Pesaran *et al*., (2001). Table C (iii) Case III. Unrestricted intercept and no trend.

investment for all five ASEAN nations. In other words, these variables do not move "too far away" from each other in the long-run.

The computed results of the long-run elasticities for CO2 and its determinants are shown in Table 3. The estimated results show that for Malaysia, GNI per capita, manufacturing value-added, and FDI significantly and positively influence the level of CO2 metric ton per capita. The estimated coefficients imply that a 1% increase in GNI per capita, manufacturing value-added, and FDI will lead to a rise in CO2 by 0.87%, 0.64%, and 0.57% respectively. The significantly positive values for coefficients β_1, and β_2 conform to the neo-liberal and FDI critics' postulations. This means that the Malaysian case conforms to the postulation that income per capita be it GDP per capita or GNP per capita is major determinant of pollution.

Table 3 Long-run Elasticities

	Malaysia	**Thailand**	**Indonesia**	**Singapore**	**Philippines**
GNI Per Capita	0.87**	0.29	0.39	0.43**	–0.5
Manufacturing Value Added (MV)	0.64**	1.82***	1.95**	1.83**	1.54**
Foreign Direct Investment (FDI)	0.57***	2.4***	–4.93***	-0.01	2.5***

Note: *** and ** denote significant at the 1%, and 5% significance levels, respectively.

For Thailand, the empirical results show that only manufacturing value-added and FDI are significant determinants of the greenhouse gas. Likewise, a 1% increase in manufacturing value-added and FDI will lead to a rise in CO2 by 1.82% and 2.4% respectively. The significantly positive value for coefficient β_2 follows the expected sign and β_3 's very significant positive coefficient shows the association between FDI and pollution. Hence, structural change and capital were more prominent in explaining the dependent variable.

Similar to Thailand's case, Indonesia's estimated results show that only manufacturing-value added and FDI significantly influence the level of CO2. While a 1 % increase in manufacturing-value added will lead to an increase by 1.95%, a 1% increase in FDI will lead to a decrease of 4.93% in CO2. The significantly positive value for coefficient β_2 is in line with the expected sign from the perspectives of neo-liberal and FDI critics, and β_2's negative sign supports proponents of neo-liberalism. Unlike, Malaysia and Thailand, transnational corporation's presence in Indonesia does not seem to aggravate pollution where only structural change and capital help explain CO2.

Singapore's estimated results indicate that only GNI per capita and manufacturing-value added explain the dependent variable while FDI proved insignificant. Hence, a 1% increase in GNI per capita and manufacturing-value added will lead to a rise of 0.43% and 1.83% in CO2 respectively. The significantly positive value for coefficients β_1, and β_2 conform to both neo-liberal perspective as well as its critics. The insignificance of β_3 renders FDI insignificant and hence, does not lend to pollution. Only the scale effect and structural change were significant in explaining CO2.

In the case of the Philippines, only β_2 and β_3 are significant with a positive coefficient of 1.54 and 2.5. Thus a 1% increase in manufacturing value-added will lead to a rise of 1.54% in CO2 levels and a 1% increase in FDI will lead to a 2.5% increase in CO2 levels. Given that β_1 is insignificant GNI per capita is insignificant in explaining CO2. In short only structural change and capital explain the dependent variable.

CONCLUSION

The study examines the relationship between pollution and foreign direct investment for five ASEAN nations spanning from 1970 to 2001 using the ARDL approach developed by Pesaran *et al.* (2001). Gross National Income per capita, and manufacturing-value added were included in the study to explain the level of CO2 metric ton per capita in each nation. Foreign direct investment was included to test the impact of FDI on pollution. Unlike the scale and capital effect, structural change consistently determined CO2 levels in all five nations. The empirical findings suggest that pollution is linked to FDI activities for Malaysia, Thailand, and the Philippines.

The empirical results demonstrate that FDI does not seem to worsen pollution levels in Indonesia. In the case of Singapore, FDI had no apparent impact on the nation's CO2 levels perhaps owning to its dominance into the tertiary sector.

Nevertheless, the findings of this study are very much confined to the years surveyed. It is recommended that future time-series research undertaken examine the impact of sectoral FDI on the level of CO2 not only to differentiate differences in pollution levels in the three main sectors-the primary, secondary, and tertiary sectors- but more importantly, determine the differences in the cleanliness of the technology brought in by multinationals to the different sectors compared to those of domestic producers. Hence, it is also proposed that FDI be expressed not in terms of GDP but in terms of gross domestic investment to test the denominator impact on the findings.

ACKNOWLEDGMENT

Much gratitude goes to Choong Chee Keong of UTAR for his generosity in instructing on the ARDL technique. Gratitude also goes to Dr. Mastura Yahya and Prof. Amer Al-Roubaie of Ahlia University for their inputs and resource materials.

REFERENCES

Bimonte, S. (2002) Information access, income distribution, and the environmental Kuznets curve. *Ecological Economics*, **41**, 145-156.

Boden, T. A., Marland, G., and Andres, R. J. (2005) Global, regional, and national CO2 emissions. In Trends: A compendium of Data on Global Change. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. Retrieved from: http://mercury.ornl.gov/cdiac/

Cole, M.A. (2004) Trade, the pollution haven hypothesis and the environmental Kuznets curve: examining the linkages. *Ecological Economica,* **48**, 71-81.

Dasgupta, S., Laplante, B., Wang, H. and Wheeler, D. (2002) Confronting the environmental Kuznets Curve. *Journal of Economic Perspectives,* **16**, 147-168.

Dickey, D. A. and Fuller, W.A. (1979) Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association,* **74**, 427-31.

Engle, R. F. and Granger, G.W.J. (1987) Cointegration and error correction: representation, estimation and testing. *Econometrics*, **35**, 143-159.

Eskeland, G. S. and Harrison, A.E. (1997) Moving to greener pastures? Multinationals and the pollution-haven hypothesis. *World Bank Policy Research Working Paper No. WPS1744,* Washington, DC.

Friedl, B. and Getzner, M. (2003) Determinants of CO2 emissions in a small open economy. *Ecological Economics,* **45**, 133-148.

Greenpeace. (2005, February) *Kyoto protocol becomes law.* Retrieved on April 24, 2005, from http://www.greenpeace.org/international/news/kyoto-protocol- becomes-law.

Goldenman, G. (1998) The environmental implication of foreign direct investment: Policy and institutional issues. OECD Paper. CCNM/EMEF/EPOC/CIME(98)3.

Johansen, S. (1988) Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, **12**, 231-254.

Johansen, S. (1991) Estimation and hypothesis testing of cointegrating vectors in Gaussian vector autoregressive models. *Econometrica,* **59**, 389-402.

Johansen, S. (1995) *Likelihood-based inference in cointegrated vector autoregressive models.* Oxford University and Press: Oxford.

Johansen, S. and Juselius, K. (1990) Maximum likelihood estimate and inferences on cointegration-with applications to demand for money. *Oxford Bulletin of Economics and Statistics*, **52**, 169-210.

Kolstad, C. D. and Xing, Y. (2002) Do lax environmental regulations attract foreign investment? *Environmental and Resource Economics*, **21**, 1-22.

Letchumanan, R and Kodama, F. (2000) Reconciling the conflict between the pollution-haven hypothesis and an emerging trajectory of international technology transfer. *Research Policy,* **29**, 59-79.

Narayan, K. N. and Smith, R. (2005) Trade liberalization and economic growth in Fiji: An Empirical Assessment using ARDL approach. *Journal of Asia Pacific Economy*, **10**, 95-115.

Organization for Economic Cooperation and Development (OECD), (2002) Environmental benefits of foreign direct investment: A literature review. (OECD Global Forum on International Investment.

Pattichis, C.A. (1999) Price and income elasticities of disaggregated import demand: results from UECMs and an application. *Applied Economics*, **31**, 1061-1071.

Pesaran, M., Shin, Y. and Smith, R. J. (2001) Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics,* **16**, 289-326.

Rock, M. T. (1996) Pollution intensity of GDP and trade policy: Can the World Bank be wrong? *World Development*, **24**, 471-479.

Shrestha, M. B. (2005) *ARDL modeling approach to cointegration test*. Retrieved on May 1, 2006 from http://www.nzae.org.nz/conferences/2005/13-SHRESTHA.PDF.pdf.

Talukdar, D. and Meisner, C. M. (2001) Does the private sector help or hurt the environment? Evidence from carbon dioxide pollution in developing countries. *World Development*, **29**, 827-840.

Tang, T. C. (2001) Bank lending and inflation in Malaysia: Assessment from unrestricted error correction models. *Asian Economic Journal*, **15**, 275-289.

Tang, T. C. (2002) Demand for M3 and expenditure components in Malaysia: Assessment from bounds testing approach. *Applied Economic Letters*, **9**, 721-725.

Tang, T. C. & Nair, M. (2002) A cointegration analysis of Malaysian import demand function: reassessment from the bounds test. *Applied Economics Letters*, **9**, 293-296.

United Nations Conference on Trade and Development (UNCTAD) Foreign Direct Investment Online Statistics. Retrieved from http://Unctad.org.

United Nations Statistical Division (UNSD) (2005) Retrieved from http://unstats.un.org/unsd/mi/mi_goals.asp.

World Bank. (2003) *World Development Indicators 2003.* CD-ROM.

Zarsky, L. (1999) Havens, halos, and spaghetti: Untangling the evidence about foreign direct investment and the environment. *OECD Paper*: CCNM/EMEF/EPOC/CIME (98)5.

Appendix:

Table A Results of the Augmented Dickey Fuller and Phillips-Perron Unit Root Tests

	Augmented Dickey Fuller		Phillips-Perron		Augmented Dickey Fuller		Phillips-Perron	
	Level				First Difference			
	Level without Trend	Level with Trend	Level without Trend	Level with Trend	Level without Trend	Level with Trend	Level without Trend	Level with Trend
Malaysia								
C02	−0.3042(0)	−2.0868(0)	−0.2063(1)	−1.9657(1)	−7.2233(0)***	−7.1246(0)***	7.1806(1)***	−7.0874(1)***
GNIPC	−1.2115(2)	−4.2516(1)	−1.2007(1)	−2.6493(1)	−5.3116(1)***	−5.3340(1)***	−4.2863(1)***	−4.2697(1)***
MV	−2.0242(0)	−2.8068(1)	−1.9364(1)	−2.4973(1)	−3.7084(0)***	−3.7907(0)**	−3.7320(1)***	−3.8216(1)**
FDI	−2.3605(0)	−2.2179(0)	−2.3410(1)	−2.1992(1)	−6.4288(0)***	−6.4249(0)***	−6.4312(1)***	−6.4311(1)***
Thailand								
CO2	−0.0837(1)	−2.1528(0)	−0.5460(1)	−1.4391(1)	−3.7825(0)***	−3.7078(0)**	−3.8031(1)***	−3.7254(1)**
GNIPC	−0.3810(0)	−2.1805(0)	−0.3900(1)	−2.2967(1)	−5.0829(0)***	−4.9916(0)***	−5.0797(1)***	−4.9897(1)***
MV	−0.6653(1)	−4.0505(0)**	−1.3868(1)	−4.0578(1)**	−7.1403(0)***	−6.9805(0)***	−7.2778(1)***	−7.0973(1)***
FDI	−2.1631(0)	−2.6250(0)	−2.2427(1)	−2.8030(1)	−5.4689(0)***	−5.4023(0)***	−5.4691(1)***	−5.4026(1)***
Indonesia								
CO2	−1.7386(0)	−2.4071(0)	−1.7472(1)	−2.4396(1)	−5.1925(0)***	−5.2254(0)***	−5.1920(1)***	−5.2252(1)***
GNIPC	−1.1841(2)	2.0593(2)	−1.3005(1)	−3.2350(1)	−6.2331(0)***	−6.1308(0)***	−5.5389(1)***	−5.3952(1)***
MV	−0.5748(0)	−4.0461(0)**	−0.3813(1)	−4.0434(1)**	−7.7230(0)***	−7.5652(0)***	−7.7077(1)***	−7.5511(1)***
FDI	−2.3341(0)	−3.3313(1)	−2.5680(1)	−2.7239(1)	−4.8473(1)***	−4.7545(1)***	−4.6976(1)***	−4.6205(1)***
Singapore								
CO2	−2.0246(0)	2.8054 (1)	−2.3412(1)	−2.1961(1)	−6.4358(0)***	−6.4243(0)***	−6.4310(1)***	−6.4315(1)***
GNIPC	−1.8183(2)	−2.9809(1)	1.6322(1)	−2.2357(1)	−4.5588(1)***	−4.9309(1)***	−3.8438(1)***	−4.0038(1)**
MV	−2.9984(0)**	−2.5717(0)	−3.0223(1)**	−2.6264(1)	−3.8747(0)***	−4.0656(0)**	−3.8580(1)***	−4.0729(1)**
PFDI	−2.3257(0)	−2.5230(0)	−2.2350(1)	−2.4422(1)	−6.5453(0)***	−6.4909(0)***	−6.5462(1)***	−6.4922(1)***
Philippines								
CO2	−1.1277(0)	−1.3474(0)	−1.1784(1)	−1.4021(1)	−5.0538(0)***	−4.9895(0)***	−5.0636(1)***	−5.0012(1)***
GNIPC	−2.0171(0)	−2.5640(0)	−2.1385(1)	−2.7002(1)	−5.5760(0)***	−5.4923(0)***	−5.4645(1)***	−5.3813(1)***
MV	−0.5867(0)	−3.1747(0)	−0.5415(1)	−3.1893(1)	−6.1027(0)***	−6.0302(0)***	−5.4645(1)***	−5.3813(1)***
FDI	−3.0493(0)**	−4.2133(0)**	−3.0100(1)**	−4.2517(1)**	−6.9338(0)***	−6.8211(0)***	−6.9564(1)***	−6.8417(1)***

Note: *** and ** denote significant at the 1% and 5% significance levels, respectively.

Table B Unrestricted Error Correction Model Results for Malaysia
Dependent variable: CO2 (Sample Period: 1977 – 2002)

Variable	Coefficient	Std. Error	t-Statistic	P-value
CO2(-1)	–1.2791	0.3690	–3.4656	0.0085
GNIPC(-1)	1.1174	0.4523	2.4701	0.0387
MV(-1)	0.8133	0.2849	2.8540	0.0213
FDI(-1)	0.7316	0.1454	5.0285	0.0010
C	–4.9970	1.5645	–3.1941	0.0127
R-squared	0.9157		Adjusted R-squared	0.7366
Diagnostic Checking			Test-Statistics	P-value
Jarque0-Bera Normality Test			0.3233	0.8507
Breusch-Godfrey LM Test (Lag 2)			3.6375	0.0923
ARCH Test (Lag 1)			2.3803	0.1365
Ramsey Reset (Lag 3)			0.7965	0.5463

Table C Unrestricted Error Correction Model Results for Thailand
Dependent variable: CO2 (Sample Period: 1977 – 2001)

Variable	Coefficient	Std. Error	t-Statistic	P-value
CO2(-1)	–0.9445	0.3021	–3.1264	0.0108
GNIPC(-1)	0.2763	0.3877	0.7125	0.4924
MV(-1)	1.7198	0.5229	3.2885	0.0082
FDI(-1)	2.3123	0.6965	3.3198	0.0077
C	–4.9135	1.4450	–3.4003	0.0068
R-squared	0.8195		Adjusted R-squared	0.5669
Diagnostic Checking			Test-Statistics	P-value
Jarque0-Bera Normality Test			0.1534	0.9261
Breusch-Godfrey LM Test (Lag 2)			2.1235	0.1821
ARCH Test (Lag 1)			1.3975	0.2497
Ramsey Reset (Lag 3)			0.7965	0.2882

Table D Unrestricted Error Correction Model Results for Indonesia
Dependent variable: CO2 (Sample Period: 1977 – 2002)

Variable	Coefficient	Std. Error	t-Statistic	P-value
CO2(-1)	–0.3184	0.1888	–1.6862	0.1226
GNIPC(-1)	0.1256	0.2244	0.5600	0.5878
MV(-1)	0.6200	0.2370	2.6161	0.0258
FDI(-1)	–1.5690	0.3697	–4.2430	0.0017
C	0.0640	0.5344	0.1197	0.9070
R-squared	0.8278		Adjusted R-squared	0.5697
Diagnostic Checking			Test-Statistics	P-value
Jarque0-Bera Normality Test			2.8991	0.2347
Breusch-Godfrey LM Test (Lag 2)			3.7792	0.0769
ARCH Test (Lag 1)			0.0047	0.9456
Ramsey Reset (Lag 3)			1.0706	0.4209

Table E Unrestricted Error Correction Model Results for Singapore
Dependent variable: CO2 (Sample period: 1976 – 2002)

Variable	Coefficient	Std. Error	t-Statistic	P-value
CO2(-1)	–0.5368	0.1473	–3.6427	0.0034
GNIPC(-1)	0.2316	0.0900	2.5719	0.0245
MV(-1)	0.9870	0.3703	2.6653	0.0206
FDI(-1)	–0.0073	0.1020	–0.0717	0.9440
C	–1.8254	0.6581	–2.7737	0.0168
R-squared	0.8157	Adjusted R-squared		0.6008
Diagnostic Checking			Test-Statistics	P-value
Jarque0-Bera Normality Test			0.7393	0.6909
Breusch-Godfrey LM Test (Lag 2)			3.3506	0.0769
ARCH Test (Lag 1)			0.7954	0.3813
Ramsey Reset (Lag 3)			0.0645	0.3905

Table F Unrestricted Error Correction Model Results for the Philippines
Dependent variable: CO2 (Sample period: 1977 – 2002)

Variable	Coefficient	Std. Error	t-Statistic	P-value
CO2(-1)	–0.8230	0.1930	–4.2626	0.0053
GNIPC(-1)	–0.4089	0.2408	–1.6977	0.1405
MV(-1)	1.2705	0.4202	3.0236	0.0233
FDI(-1)	2.0906	0.3851	5.4286	0.0016
C	–2.2345	1.3585	–1.6447	0.1511
R-squared	0.9480	Adjusted R-squared		0.7836
Diagnostic Checking			Test-Statistics	P-value
Jarque0-Bera Normality Test			1.5429	0.4623
Breusch-Godfrey LM Test (Lag 2)			0.6757	0.5436
ARCH Test (Lag 1)			0.0084	0.9278
Ramsey Reset (Lag 3)			0.7965	0.0645