

Foreign Direct Investment, Pollution and Economic Growth:  
Evidence from Malaysia

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**Abstract**

The bounds test developed by Pesaran et al. (2001) is applied to examine the existence of a long-run relationship between FDI inflows, pollution and output of Malaysia. Granger causality tests are also utilized to test for the presence of the short-run and long-run causal relationship between these variables. Both FDI inflows and pollution have short-run causal relationship on output. Output only has long-run causal relationship on FDI inflows.

Keywords: Causality; FDI; Growth; Pollution

JEL classification: O10, Q56

## **I. Introduction**

The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967 with five founding members, namely, Indonesia, Malaysia, Philippines, Singapore and Thailand. Hereafter, these five countries are called ASEAN-5. The ASEAN-5, except Philippines, have been classified by the World Bank (1993) as “miracle” economies. Singapore is also one of the countries falling into the classification of newly industrialized economies. The remaining 4 of the ASEAN-5 are developing economies. Some of the ASEAN-5 were able to move from low level of economic activity in the early 1970s to fairly high levels of GDP per capita in the early 2000s as shown in Table 1. During 1961-2001, average annual growth rates of these economies exceeded 4 per cent per decade, except Philippines. In particular, Malaysia and Singapore had average annual growth rates exceeding 6 per cent per decade. This is reported in Table 2. Excluding Singapore which is already an industrialized economy and has been classified by the World Bank as one of the high-income economies, Malaysia has the highest GDP per capita among the ASEAN-5.

**[Insert Table 1 here]**

**[Insert Table 2 here]**

Why have majority of the ASEAN-5 flourished whilst other developing countries and regions have not? Foreign direct investment (hereafter FDI)

inflows are believed to be a major engine for the rapid economic growth in these countries. It is not unusual for researchers to emphasize the importance of FDI in fueling economic growth (see Yao, 2006; Kottaridi, 2005; Le and Suruga, 2005; Shan, 2002). Fan and Dickie (2000) use growth accounting method to show FDI inflows have contributed to the development of the ASEAN-5. Table 3 reports FDI inflows into each of the ASEAN-5. Table 4 shows the FDI inward stock in each of the ASEAN-5. Among the developing ASEAN-5, Malaysia has the largest FDI inward stock. It has also exhibited a consistently strong record of attracting FDI inflows during 1980s, 1990s and 2000s among the developing ASEAN-5. Malaysia was the second largest FDI recipient among Southeast Asian countries in 1995 (UNCTAD, 1996a). It is also consistently ranked as one of the top 12 recipients of FDI among developing countries since 1970 (IFC, 1997). Political and macroeconomic stability, adequate infrastructure and well-conceived investment promotion strategies of Malaysia have been identified as responsible for the attraction of FDI inflows into this country.

**[Insert Table 3 here]**

**[Insert Table 4 here]**

In this study, I would like to address the important question of whether FDI inflows enhance economic growth in Malaysia. The selection of Malaysia is based, in part, on its abilities to maintain sustained rapid growth over the

past 40 years and to attract substantial inflows of FDI which are difficult to be matched by many of the developing countries. Further, the World Bank (1993) has stressed the relevance of the experience of ASEAN countries to many developing economies because of their initial conditions which are parallel to many other developing countries. I do not consider Singapore for this study despite its impressive economic performance. Being a city state with limited natural endowments of land and resources, the experience of Singapore could be rather difficult to be learnt by many developing countries.

Lim (2004) has pointed out the success of the economies in ASEAN has been achieved at the expense of their environment. Grossman and Krueger (1995) have shown that economic growth leads to environmental deterioration until GDP per capita of a country is less than \$8000 (1985 dollars). Sobhee (2004) has even developed a theoretical framework regarding the relationship between environmental degradation and income per capita. He hypothesises that environmental degradation accelerates and then decelerates at low levels of income per capita, and falls at higher income per capita. Concerned with the problem of increasing environmental degradation, I examine the nature of the relationship between the level of economic activity or income and environmental quality. Many of the existing literature have also stressed that the relatively lax environmental regulations in the developing countries attract FDI (see Grossman and Krueger, 1991; Friedman et al., 1992; Smarzynska and Wei, 2001; Xing and Kolstad, 2002). This has necessitated

the investigation of the relationship between FDI inflows and environment in this study.

Recent empirical and theoretical works have tried to establish the connection either between FDI inflows and economic growth, between FDI inflows and pollution or between pollution and economic growth. A subset of these works has employed Granger causality tests to determine the direction of causality in one of these connections, for instance, FDI and Pollution: Hoffmann et al. (2005); FDI and economic growth: Ericsson and Irandoust (2001), Chakraborty and Basu (2002) and Liu et al. (2002); pollution and economic growth: Coondoo and Dinda (2002). But, limited to my knowledge, none studies the causal link of these three variables together.

Ericsson and Irandoust (2001) use the test developed by Toda and Yamamoto (1995) and Yamada and Toda (1998) to investigate the Granger causality between the annual growth rate of real GDP per capita and the rate of change of FDI inflows for Denmark, Finland, Norway and Sweden. They find that there is a bidirectional causal linkage between these two variables for Sweden, the causality is from FDI growth to GDP per capita growth for Norway and there is no causality for Denmark and Finland.

Chakraborty and Basu (2002) explore the cointegrating relationship between net inflow of FDI, real GDP, unit cost of labour and the proportion of import duties in tax revenue for India with the method developed by Johansen and

Juselius (1990). They find two long-run equilibrium relationships. The first relationship is between net inflow of FDI, real GDP and the proportion of import duties in tax revenue and the second is between real GDP and unit cost of labour. They find unidirectional Granger causality from real GDP to net inflow of FDI.

Liu et al. (2002) investigate the causal links between GDP, FDI, exports and imports in China with the methods developed by Johansen (1988) and Hall and Milne (1994). They show that each of these variables is weakly caused by the remaining variables with the tests proposed by Hall and Milne (1994). They also provide evidence to support the presence of bi-directional short-run causal links between GDP, FDI and exports. But, uni-directional causal link can be found from GDP, FDI and exports to imports.

Hoffmann et al. (2005) employ the first of the three steps proposed by Hurlin and Venet (2001) to identify Granger causality between CO<sub>2</sub> emission and net inflow of FDI in panel data. Their findings indicate that there is a unidirectional Granger causality from CO<sub>2</sub> emission to net inflow of FDI for low income countries, a unidirectional Granger causality from net inflow of FDI to CO<sub>2</sub> emission for middle income countries and no Granger causality for high income countries.

Coondoo and Dinda (2002) divide the countries into groups and continents. Granger causality test is applied by them to real GDP per capita and CO<sub>2</sub>

emission based on aggregate time series and panel data for each country group or continent. Fixed effect specification and within regression method have been applied to country/continent specific panel data. They conclude that there is a one-way causality from CO<sub>2</sub> emission to real GDP per capita for North America, Western Europe and Eastern Europe, a one-way causality from real GDP per capita to CO<sub>2</sub> emission for Central and South America, Oceania and Japan and a two-way causality for Asia and Africa.

I believe that this country specific study overcomes the limitations of existing empirical studies. This paper is, probably, the first that investigates the connections of FDI inflows, pollution and output simultaneously. It demonstrates the use of an appropriate statistical procedure for estimating cointegration when sample size is small. The bounds test developed by Pesaran et al. (2001) is used to overcome many shortcomings of alternative methods which are commonly used in existing empirical literature. It integrates the short-run and long-run relationships of these three variables within an empirical framework. The works of Hoffmann et al. (2005) and Coondoo and Dinda (2002) only capture the short-run relationship. Further, recent research is unable to provide conclusive empirical evidence to support the long-run effect of FDI on output, for instance, Bende-Nabende et al. (2003) find a positive long-run effect of FDI on output for Philippines and Thailand, a negative long-run effect for Taiwan and no relationship for Hong Kong. Given that FDI inflows, pollution and output causality may vary from one country to another, the findings of this paper can provide a meaningful

policy discussion for Malaysia, which has experienced a rapid economic growth since the last four decades.

The rest of this paper is presented as follows. Section II describes the data sources, presents the econometric methodology, and analyses the empirical findings. Section III concludes this paper with implications for policy purposes.

## **II. Data, Methodology and Results**

In this study I have used annual real GDP per capita (GDP) and annual per capita CO<sub>2</sub> emission (CO<sub>2</sub>) as the proxies of income and pollution, respectively. The use of CO<sub>2</sub> as a proxy for pollution is discussed in Hoffmann et al. (2005). GDP is taken from the Penn World Table Version 6.1, CO<sub>2</sub> from World Development Indicators Online and FDI inflows from UNCTAD (<http://www.unctad.org>) for the period 1970 to 2000.

The bounds test within the autoregressive distributed lag (ARDL) framework and based on the F-statistic proposed by Pesaran et al. (2001) is used to test for cointegration. This test is utilized here because it has better small sample properties in comparison to other widely used alternatives such as the Engle and Granger (1987), Johansen (1988) and Johansen and Juselius (1990) approaches. Pesaran and Shin (1999) show that the ARDL based estimators of the long-run coefficients are super-consistent. Other approaches such as Engle-Granger and Johansen methods of cointegration are well-known to be



unreliable for small sample sizes. Therefore, studies involving detection of cointegration using annual data are increasingly employing the bounds test. For instance, Pattichis (1999) estimates disaggregated import demand for Cyprus from 1975 to 1994; Tang (2002) estimates demand for M3 in Malaysia from 1973 to 1998; Tang and Nair (2002) estimate Malaysian import demand from 1970 to 1998; Narayan and Smyth (2003) examine the long-run relationship between attendance, real male average weekly earnings in the state of Victoria and real admission price at the Melbourne Cup from 1960 to 2002. All these studies have used a sample with less than 30 observations, except the one by Narayan and Smyth (2003).

The bounds test can be used irrespective of whether the variables are pure  $I(1)$ ,  $I(0)$  or mutually cointegrated. This allows us to avoid the problem associated with conflicting results of the conventional unit root tests, such as Dickey and Fuller (1979, 1981), Philips and Perron (1988) and Kwiatkowski et al. (1992) and the low power of these tests. Furthermore, the Engle-Granger and Johansen methods are typically affected by pretests on unit roots and subsequent tests of cointegrating relations. Since most of macroeconomic variables are either  $I(1)$  or  $I(0)$ , unit root tests are not conducted in this study.

The bounds test examines whether a long-run relationship exists in one of the following equations:

$$\Delta \text{GDP}_t = a_0 + \sum_{i=1}^n a_{Gi} \Delta \text{GDP}_{t-i} + \sum_{i=1}^n a_{Fi} \Delta \text{FDI}_{t-i} + a_1 \text{GDP}_{t-1} + a_2 \text{FDI}_{t-1} + \varepsilon_{1t} \quad (1)$$

$$\Delta \text{GDP}_t = b_0 + \sum_{i=1}^n b_{Gi} \Delta \text{GDP}_{t-i} + \sum_{i=1}^n b_{Ci} \Delta \text{CO2}_{t-i} + b_1 \text{GDP}_{t-1} + b_2 \text{CO2}_{t-1} + \varepsilon_{2t} \quad (2)$$

$$\Delta \text{FDI}_t = c_0 + \sum_{i=1}^n c_{Fi} \Delta \text{FDI}_{t-i} + \sum_{i=1}^n c_{Gi} \Delta \text{GDP}_{t-i} + c_1 \text{FDI}_{t-1} + c_2 \text{GDP}_{t-1} + \varepsilon_{3t} \quad (3)$$

$$\Delta \text{FDI}_t = d_0 + \sum_{i=1}^n d_{Fi} \Delta \text{FDI}_{t-i} + \sum_{i=1}^n d_{Ci} \Delta \text{CO2}_{t-i} + d_1 \text{FDI}_{t-1} + d_2 \text{CO2}_{t-1} + \varepsilon_{4t} \quad (4)$$

$$\Delta \text{CO2}_t = e_0 + \sum_{i=1}^n e_{Ci} \Delta \text{CO2}_{t-i} + \sum_{i=1}^n e_{Gi} \Delta \text{GDP}_{t-i} + e_1 \text{CO2}_{t-1} + e_2 \text{GDP}_{t-1} + \varepsilon_{5t} \quad (5)$$

$$\Delta \text{CO2}_t = f_0 + \sum_{i=1}^n f_{Ci} \Delta \text{CO2}_{t-i} + \sum_{i=1}^n f_{Fi} \Delta \text{FDI}_{t-i} + f_1 \text{CO2}_{t-1} + f_2 \text{FDI}_{t-1} + \varepsilon_{6t} \quad (6)$$

The null hypothesis of no cointegration of each equation is stated in the second column of Table 5. To minimize the loss of degree freedom and to fulfill the assumption of no autocorrelation required by the bounds test, the value of  $n$  corresponding to each equation is increased till the Breusch-Godfrey Lagrange multiplier test is unable to reject the null of no autocorrelation up to lag order 2 at 5% significance level. Results in Table 5 shows that cointegration only happens in Equation 3. It is clear that there is a long-run relationship between FDI and GDP when FDI is the dependent variable but long-run relationship between GDP and FDI when GDP is the dependent variable is not found. Granger (1988) points out there will be causality between FDI and GDP at least in one direction if there exists a cointegration between them. Based on Granger's suggestion and the results of the bounds test, I conclude that the long-run causality is from GDP to FDI.

The optimal lags of ARDL where FDI is the dependent variable, and lagged FDI together with current and lagged GDP as independent variables is selected with Schwarz Bayesian criterion. Solving this ARDL, the long-run coefficients are reported in Table 7 as error correction term (ECT).

**[Insert Table 5 here]**

Granger (1986) and Engle and Granger (1987) suggest a test of causality to take into account the properties of cointegrated variables which can be expressed as an error correction model (ECM). Based on the results of the bounds test, Equations (1) to (6), except Equation (3), are reestimated without the lagged levels of the variables. The standard Granger causality test is applied on them. To test for Granger causality in Equation (3), it is modified to capture cointegration as shown by Equation (7)

$$\Delta FDI_t = c_0 + \sum_{i=1}^n c_{Fi} \Delta FDI_{t-i} + \sum_{i=1}^n c_{Gi} \Delta GDP_{t-i} + \gamma ECT_{t-1} + \varepsilon_{3t} \quad (7)$$

Since  $ECT_{t-1}$  of Equation (7) is not observable, it is replaced by  $\hat{E}_{t-1}$  as reported in Table 7. The selected value of n for each modified equation is identical to that reported in Table 5 as long as there is no autocorrelation. The results of short-run and long-run Granger causality are reported in Tables 6 and 7. The coefficient of the lagged ECT also has the right sign. These results suggest that a) there is a unidirectional short-run Granger

causality running from FDI to GDP, b) there is a unidirectional short-run Granger causality running from CO2 to GDP, c) there is a unidirectional short-run Granger causality running from FDI to CO2 and d) there is a unidirectional long-run Granger causality running from GDP to FDI. All these are summarized in Figure 1.

**[Insert Table 6 here]**

**[Insert Table 7 here]**

**[Insert Figure 1 here]**

### **III. Conclusions and Policy Implications**

In this study, I find that FDI inflows play a significant role in the adjustment of GDP per capita. This is consistent with existing literature which emphasizes that FDI inflows may bring essential economic resources to facilitate the development of the host countries. Interestingly, the empirical results indicate that FDI inflows explain only the short-run adjustment of GDP per capita and not the long-run. These results suggest that FDI inflows may act as positive stimuli for Malaysia, but not as an engine for sustained economic growth because Lee (2005) has suggested FDI may not always serve the long-run interests of the host countries. Lee (2005) points out that the instability and inconsistency of FDI inflows, the economic cycle of the investors' home countries and political considerations reduce the importance

of FDI as an engine for sustained economic development. These three factors can lead to the divestment of foreign firms that disrupt the development plans of the host countries.

Solow (1956) growth model can be used to explain why FDI may not be a source of long-term economic growth. This model predicts that, in steady state, GDP per capita grows at the rate of technological progress. A one-off technological change only leads to a change in GDP per capita. For the host countries, FDI inflows create positive externalities through the "spillover effect" (see Caves, 1974; Globerman 1979; Blomstrom and Persson, 1983; Athukorala and Menon, 1996). When FDI flows into a host country, FDI may transfer new ideas, technologies and managerial skills to domestic firms. During this process, domestic firms may experience an improvement in technology and productivity of domestic workers may increase. FDI can contribute to technological progress of the host countries. But, foreign firms may not provide continuous technological assistance, such as introduction of new technologies and training of workers, to domestic firms. Therefore, a host country may only experience a one-off technological change. GDP per capita will only increase when foreign technology and best business practices are made available by foreign firms to domestic firms.

In the long-run, GDP per capita has a positive effect on FDI inflows. FDI inflows are largely explained by GDP per capita which defines the size of the domestic market and the provision of infrastructure and human capital (see

Deichmann et al., 2003; Filippaios et al., 2003). Economic growth provides larger and growing markets for the foreign firms. The larger the host country the greater the likelihood that foreign firms will be able to recover their fixed cost through economies of scale. The presence of adequate infrastructure: telecommunication, transport and power supply encourages FDI inflows because it decreases transaction costs and increases the productivity of investments. Public expenditure in the areas of infrastructure and human capital can play an important role in encouraging FDI inflows. Economic growth appears to provide the need for and the resources to fund the development of better education and infrastructure because the levels of spending on them are usually as a proportion of GDP. Rapid economic growth and improving living standards also have positive impact on educational attainment that makes appropriate skills required by the foreign firms available. The infrastructural and human capital developments take place in response to the expansion of the economy, while also positively impacting on inflow of FDI in their own right.

In the short-run, FDI inflows play a significant role in environmental degradation. The environmental degradation appears to have significant impact on the short-run adjustment of GDP per capita. More capital investment associated with polluting industries flow into Malaysia due to lax environmental policy and lenient environmental regulations. Some economic activities associated with the deterioration of environmental quality and energy consumption are the main sources of growth in developing countries,

due to the structure of the economy. Most empirical studies have shown that energy consumption changes have a high correlation with economic growth (see Ferguson et al., 2000). Therefore, an increase in pollution explains the short-run changes in GDP per capita.

My most important conclusion, to which all these results point, is that the conventional wisdom that FDI is one of the factors for sustained economic growth can be wrong. It is clear from this analysis that the effects of FDI on the growth of output per capita of Malaysia can be regarded as being transitory, rather than permanent. Economic policy promoting FDI inflows is only an instrument in the stimulation of short-term economic expansion. Malaysia should invest in its people, new technology and infrastructure to foster continued economic growth, rather than adopting incentive schemes under the classifications of UNCTAD (1996b): fiscal incentives, financial incentives and other incentives, to create favorable conditions to attract more FDI. Whilst energy conservation and strict environmental regulations may temporarily harm the expansion of the economy, it is clear that the appropriate response to environmental problems will not prevent the long-term expansion of the economy.

Table 1. GDP per capita in constant 2000 US dollars for ASEAN-5

<b>Country</b>	<b>1970</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>
<b>Indonesia</b>	235	397	612	800
<b>Malaysia</b>	1103	1848	2547	3927
<b>Philippines</b>	733	989	920	1002
<b>Singapore</b>	4434	8926	14401	22768
<b>Thailand</b>	530	804	1452	1998

Source: World Development Indicators Online, World Bank

Table 2. Average annual growth rates of GDP for ASEAN-5

<b>Country</b>	<b>1961-1970</b>	<b>1971-1980</b>	<b>1981-1990</b>	<b>1991-2001</b>
<b>Indonesia</b>	4.2	7.9	6.4	4.3
<b>Malaysia</b>	6.5	7.9	6.0	6.6
<b>Philippines</b>	4.9	5.9	1.8	2.9
<b>Singapore</b>	10	9.0	7.4	7.0
<b>Thailand</b>	8.2	6.9	7.9	4.4

Source: Data from Lim (2004), pp.43

Table 3. Foreign direct investment inflows into ASEAN-5 (in millions of US dollars)

<b>Country</b>	<b>1970</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>
<b>Indonesia</b>	145	300	1092	-4550
<b>Malaysia</b>	94	934	2611	3788
<b>Philippines</b>	-1	-106	550	1345
<b>Singapore</b>	93	1236	5575	16485
<b>Thailand</b>	43	189	2575	3350

Source: UNCTAD (<http://www.unctad.org>)

Table 4. Foreign direct investment inward stock in ASEAN-5 (in millions of US dollars)

<b>Country</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>
<b>Indonesia</b>	4680	8855	24780
<b>Malaysia</b>	5169	10318	52747
<b>Philippines</b>	1281	3268	12810
<b>Singapore</b>	6203	30468	112571
<b>Thailand</b>	981	8242	29915

Source: UNCTAD (<http://www.unctad.org>)



Table 5. The results of the bounds test for cointegration

Equation	H <sub>0</sub>	n	LM(1)	LM(2)	F-value
(1)	a <sub>1</sub> =a <sub>2</sub> =0	2	1.2306	2.3662	0.4706
(2)	b <sub>1</sub> =b <sub>2</sub> =0	1	0.5625	3.2442	1.8721
(3)	c <sub>1</sub> =c <sub>2</sub> =0	1	0.3961	2.0590	5.2501*
(4)	d <sub>1</sub> =d <sub>2</sub> =0	1	2.1937	4.6074	1.7731
(5)	e <sub>1</sub> =e <sub>2</sub> =0	1	0.0031	1.8769	1.5531
(6)	f <sub>1</sub> =f <sub>2</sub> =0	3	2.8206	4.1763	0.5691

\*, \*\* and \*\*\* indicate statistically significant at 10%, 5% and 1% levels, respectively.

Critical values are obtained from Table CI(iii) in Pesaran et al. (2001).

LM(*i*) is the Breusch-Godfrey Lagrange multiplier test based on the null of no autocorrelation up to lag order *i*.

Table 6. The results of Granger's causality test: short-run

Dependent Variable	ΔGDP	ΔFDI	ΔCO <sub>2</sub>
ΔGDP		12.8096***	6.4939**
ΔFDI	1.5821		0.0030
ΔCO <sub>2</sub>	2.2637	4.1392**	

\*, \*\* and \*\*\* indicate statistically significant at 10%, 5% and 1% levels, respectively.

This causality test is conducted based on the null of lagged first differences of other variable are jointly insignificant.

Table 7. The results of Granger's causality test: long-run

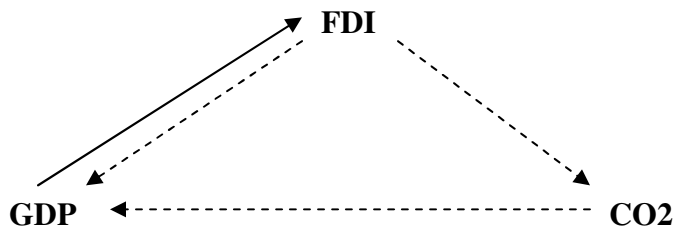
ECT	Coefficient of ECT <sub>t-1</sub>	t-value	F-value
$\hat{E}_t = FDI_t + 806.1901 - 0.6662GDP_t$	-0.41103	-2.23573**	2.704621*

\*, \*\* and \*\*\* indicate statistically significant at 10%, 5% and 1% levels, respectively.

t-value is the t-statistics on the coefficient of the lagged ECT.

F-value is the F-statistics on the null of lagged first differences of GDP and lagged ECT are jointly insignificant.

Figure 1



X-----> Y indicates X Granger causes Y in the short-run

X-----> Y indicates X Granger causes Y in the long-run

## References

Athukorala, P. and Menon, J. (1996) Foreign investment and industrialization in Malaysia: exports, employment and spillover, *Asian Economic Journal*, **10**, 29-44.

Bende-Nabende, A., Ford, J.L., Santoso, B. and Sen, S. (2003) The interaction between FDI, output and the spillover variables: cointegration and VAR analyses for APEC, 1965-1999, *Applied Economics Letters*, **10**, 165-72.

Blomstrom, M. and Persson, H. (1983) Foreign investment and spillover efficiency in an underdeveloped economy: evidence from the Mexican manufacturing industry, *World Development*, **11**, 493-501.

Caves, R.E. (1974) Multinational firms, competition and productivity in host country market, *Economica*, **41**, 176-93.

Chakraborty, C. and Basu, P. (2002) Foreign direct investment and growth in India: a cointegration approach, *Applied Economics*, **34**, 1061-73.

Coondoo, D. and Dinda, S. (2002) Causality between income and emission: a country group-specific econometric analysis, *Ecological Economics*, **40**, 351-67.

Deichmann, J., Karidis, S. and Sayek, S. (2003) Foreign direct investment in Turkey: regional determinants, *Applied Economics*, **35**, 1767-78.

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

Dickey, D.A. and Fuller, W.A. (1981) Likelihood ratio statistics for autoregressive time series with a unit root, *Econometrica*, **49**, 1057-72.

Engle, R.F. and Granger, C.W.J. (1987) Cointegration and error correction representation: estimation and testing, *Econometrica*, **55**, 251-76.

Ericsson, J. and Irandoust, M. (2001) On the causality between foreign direct investment and output: a comparative study, *International Trade Journal*, **15**, 1-26.

Fan, X. and Dickie, P.M. (2000) The contribution of foreign direct investment to growth and stability: a post-crisis ASEAN-5 review, *ASEAN Economic Bulletin*, **17**, 312-23.

Ferguson, R., Wilkinson, W. and Hill, R. (2000) Electricity use and economic development, *Energy Policy*, **28**, 923-34.

Filippaios, F., Papanastassiou, M. and Pearce, R. (2003) The evolution of US outward foreign direct investment in the pacific rim: across-time and country analysis, *Applied Economics*, **35**, 1779-87.

Friedman, J. Gerlowski, D.A. and Silberman, J. (1992) What attracts foreign multinational corporations? Evidence from branch plant location in the United States, *Journal of Regional Science*, **32**, 403-18.

Globerman, S. (1979) Foreign direct investment and 'spillover' efficiency benefits in Canadian manufacturing industries, *Canadian Journal of Economics*, **12**, 42-56.

Granger, C.W.J. (1986) Developments in the study of cointegrated economic variables, *Oxford Bulletin of Economics and Statistics*, **48**, 213-28

Granger, C.W.J. (1988) Some recent developments in a concept of causality, *Journal of Econometrics*, **39**, 199-211.

Grossman, G.M. and Krueger, A.B. (1991) Environmental impacts of a North American free trade agreement, *NBER Working Paper No. 3914*.

Grossman, G.M. and Krueger, A.B. (1995) Economic growth and the environment, *Quarterly Journal of Economics*, **110**, 353-77.

Hall, S. and Milne, A. (1994) The relevance of p-star analysis to UK monetary policy, *The Economic Journal*, **104**, 597-604.

Hoffmann, R., Lee, C.G., Ramasamy, B. and Yeung, M. (2005) FDI and pollution: a Granger causality test using panel data, *Journal of International Development*, **17**, 311-17.

Hurlin, C. and Venet, B. (2001) Granger causality tests in panel data models with fixed coefficients, *EURIsCo Working Paper 2001-09*, University Paris IX.

IFC (1997) *Foreign Direct Investment, Report No. 5*, World Bank, Washington DC.

Johansen, S. (1988) Statistical analysis of cointegration vectors, *Journal of Economic Dynamic and Control*, **12**, 231-54.

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

Kottaridi, C. (2005) The 'core-periphery' pattern of FDI-led growth and production structure in the EU, *Applied Economics*, **37**, 99-113.

Kwiatkowski, D., Peter, C.B.P., Schmidt, P. and Shin, Y. (1992) Testing the null hypothesis of stationary against the alternative of a unit root, *Journal of Econometrics*, **54**, 159-78.

Le, M.V. and Suruga, T. (2005) Foreign direct investment, public expenditure and economic growth: the empirical evidence for the period 1970-2001, *Applied Economics*, **12**, 45-9.

Lee, Y. S. (2005) Foreign direct investment and regional trade liberalization: a viable answer for economic development?, *Journal of World Trade*, **39**, 701-17.

Lim, C.Y. (2004) *Southeast Asia the long road ahead*, 2<sup>nd</sup> edition, World Scientific, Singapore.

Liu, X., Burridge, P. and Sinclair, P.J.N. (2002) Relationships between economic growth, foreign direct investment and trade: evidence from China, *Applied Economics*, **34**, 1433-40.

Narayan, P.K. and Smyth, R. (2003) Attendance and pricing at sporting events: empirical results from Granger Causality Tests for the Melbourne Cup, *Applied Economics*, **35**, 1649-57.

Pattichis, C. A. (1999) Price and income elasticities of disaggregated import demand: results from UECMs and an application, *Applied Economics*, **31**, 1061-71.

Pesaran, H. and Shin, Y. (1999) An autoregressive distributed lag modeling approach to cointegration analysis, in *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, (Ed.) S. Strom, Cambridge University Press, Cambridge.

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

Phillips, P.C.B. and Perron, P. (1988) Testing for a unit root in time series regression, *Biometrika*, **75**, 335-59.

Shan, J. (2002) A VAR approach to the economics of FDI in China, *Applied Economics*, **34**, 885-93.

Smarzynska, B.K. and Wei, S.J. (2001) Pollution havens and foreign direct investment: dirty sector or popular myth? *NBER Working Paper No 8465*.

Sobhee, S.K. (2004) The environmental Kuznets curve (EKC): a logistic curve? *Applied Economics Letters*, **11**, 449-52.



Solow, R.M. (1956) A contribution to the theory of economic growth, *Quarterly Journal of Economics*, **70**, 65-94.

Tang, T.C. (2002) Demand for M3 and expenditure components in Malaysia: assessment from bounds testing approach, *Applied Economics Letters*, **9**, 721-25.

Tang, T.C. and Nair, M. (2002) A cointegration analysis of Malaysian import demand function: reassessment from the bounds test, *Applied Economics Letters*, **9**, 293-6.

Toda, H.Y. and Yamamoto, T. (1995) Statistical inference in vector autoregressions with possibly integrated processes, *Journal of Econometrics*, **66**, 225-50.

UNCTAD (1996a) *World Investment Report 1996*, United Nations, New York.

UNCTAD (1996b) Incentives for foreign direct investments, *Current Studies* A30.

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

Yamada, H. and Toda, H.Y. (1998) Inference in possibly integrated vector autoregressive models: some finite sample evidence, *Journal of Econometrics*, **86**, 55-95.

Yao, S. (2006) On economic growth, FDI and exports in China, *Applied Economics*, **38**, 339-51.

World Bank (1993) *The East Asian Miracle: Economic Growth and Public Policy*, Oxford University Press, New York.