Environmental Impact of Thailand's Trade with OECD

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Introduction

To promote liberal trade while maintaining and strengthening protection of the environment and natural resources is one of the major policy challenges of the decade. International trade contributes to economic growth, benefits all participating countries, while growth, in turn, increases the demand for environmental quality. This complex relationship between trade and the environment has generated debate. Two conflicting hypotheses have emerged from the debate. The first one, the pollution haven hypothesis (PHH), suggests that developed countries impose tougher environmental policies, the result of which distorts existing patterns of comparative advantage. When the polluting industries shift operations from the developed to the developing countries, developing countries thus become "pollution havens." The second hypothesis, the factor endowment hypothesis (FEH), predicts that trade liberalisation will result in trade patterns consistent with the Heckscher-Ohlin-Vanek (HOV) theory of comparative advantage based on factor endowment differentials. Developed countries are well endowed with capital. Since capital-intensive goods are often also pollution-intensive, factor endowment theories of international trade predict that developed countries specialize in polluting goods. Thus the manifestation of the PHH is in direct conflict with the FEH. This debate is of great concern among economists, environmentalists and world bodies like the World Trade Organization
.
Thailand is a good laboratory for testing these two hypotheses. Among all South and Southeast Asian countries Thailand can be regarded as one of the fastest growing economies. The average annual growth rate between 1980 and 2004 is around seven percent. Liberalised trade policy has been the main driver and corner stone of this growth.

Thai exports have increased significantly by 45% (1980-85), 342% by 1990, 955% by 1995 & a staggering 2406% by 2003. Few countries in the world could claim this kind of dramatic growth in any sector of their economies. The composition of exports has also changed. Just as exports experienced rapid growth so have imports in Thailand.

The Organization of Economic Cooperation and Development (OECD) is a major trading partner of Thailand and holds a consistent share of approximately 55% of the country's total trade from 1980 to 2000. Thai exports to the OECD doubled in value terms with diversification since the mid-1990s whereas imports from the OECD followed a less regular trend. The main exports to the OECD include machinery, garments, motor vehicles and parts, and electronics. Imports consist mainly of machinery, electrical items and parts. In terms of investment the OECD's share was more than 65% in 2000, the most important source of foreign direct investment (FDI) in Thailand, followed by the Asian NIEs. Thailand's intra-industry has also grown significantly.

The diversification of the structure of Thailand's trade with the OECD and also the inflow of FDI has important implications for the environment. Literature linking trade and the environment is growing (Tobey, 1990; Lucas, et al.1992; Low and Yeates, 1992; Mani and Wheeler, 1998; Cole and Elliot 2001; Xing and Kolstad, 2002; Eskeland & Harrison, 2003; Copeland and Taylor, 2003; Smarzynska and Wei, 2004; Waldkirch and Gopinath, 2004). Several attempts have used the Input-Output model to address the issue (Wyckoff and Roop 1994; Gale and Lewis 1995; Antweiler 1996; Proops et al. 1999; Machado et al. 2001; Munksgaard and Pedersen 2001; Wadeskog 2002) but only a few have addressed the PHH and FEH using the Input-Output model (Mukhopadhyay 2004; Mukhopadhyay & Chakraborty, 2005 a, b).

The literature cited above indicates that the debate is still open. The methodologies employed to test the hypotheses are widely varied and so are the results. Discussions on Thailand's trade-environmental relation received attention in recent years (TDRI 1996, 2000; Jha et al.1999; TEI 2000) but unfortunately, no comprehensive work has been done on it, in particular using I-O techniques.

The objective of this study is to evaluate the environmental impact of Thailand's trade with the OECD using the two conflicting hypotheses/theories (pollution haven and factor endowment) from 1980 to 2000. It will also analyse the implications of FDI from OECD on the environment.

Methodology and Data Source

The methodology of the current research is based on Leontief's Input-Output framework (1951). This is a method of systematically quantifying the mutual interrelationships among the various sectors of a complex economic system. The structure of the input-output model can be framed as follows:

$X = A_d X + Y$ --------- (1)
Or, $X = (I - A_d)^{-1} Y$ ……. (1a)

Here X defines the vector of domestic output, Ad is the matrix of domestic input-output coefficient and $[I- A_d]^{-1}$ is the Leontief domestic inverse matrix. Now an emission model can be formulated through (1a).

Emission model

The total amount of an emission from fossil fuel combustion can be calculated as a function of output of industries (Mukhopadhyay & Forssell, 2005).

$$\mathbf{F_{pd} = CL1X_d = C\ L1\ (I - A_d)^{-1} Y} \qquad \textbf{--------- (2)}$$

Here F_{pd} is a scalar giving the total quantity of emission from fossil fuels combustion in Thailand. Emissions in this study are CO_2, SO_2 and NOx defined as pollution type p. C is a vector of dimension m (1xm), coefficients for the industrial emission intensity per unit of fossil fuel burnt. L1 is a matrix (mxn) of the industrial consumption in energy units of m types of fuel per unit of total output of n industries. In equation (2) CL1 carries only direct requirement of pollution intensities from industries and C L1 $(I - A_d)^{-1}$ gives the direct as well as indirect requirement of pollution from industries.

Let CL1 = S and $(I - A_d)^{-1}$ = R. Then equation (2) will be

F_{pd} = SR Y ---------- (2a)

Pollution Haven Hypothesis

To establish a link between trade and the environment we need to develop the trade model by extending the equation (2a).

Trade model

By separating the final demand vector as domestic (Yd) and net exports we get

Y= Yd + Yx -Ym ---------- (3)

Where Yx (nx1) and Ym(nx1) are defined as the vector of export and imports respectively. Here we assume identical technology (Heckscher-Ohlin) to find out the pollution content of imports from the OECD. So the pollution content of export and import can be defined as follows:

F_{pd} exp_{oecd} = SR Yx_{oecd} -------- (4)
F_{pd} imp_{oecd} = S R Ym_{oecd} -------- (5)

The sectoral contribution of the pollution (CO_2, SO_2 and NOx) content of export and import is estimated by putting export and import vectors as diagonal matrix.
Now, a measure of pollution terms of trade (PTOT) for Thailand with the OECD will be derived by equation (4) and (5).

$PTOT_{pd\ oecd}$ = $F_{pd}exp_{oecd}$ / $F_{pd}imp_{oecd}$ = [SRYx_{oecd}] / [SRYm_{oecd}] --------- (6)

The pollution terms of trade (equation 6) indicates the ratio of the pollution content of 1 unit of exports relative to the pollution content of 1 unit of imports. When the pollution terms of trade are greater (smaller) than 100, then that particular country's exports contain more (less) pollution than it is receiving through imports. The expressions of (6) will provide the compositional effect. This indicator has been used to reflect pollution haven effect.

Factor Endowment Hypothesis

The HOV model which focuses on the relationship between production factors and trade predicts that a country will export services of the factors that are relatively abundant in the country and will import services of the factors that are relatively scarce in the country. For the factor endowment hypothesis we have modified previous equations by introducing sectoral labour and capital coefficients and also export and import vector.
Recollecting equation (2a), the following equations (7-10) can be derived to estimate the total labour and capital requirements in exports and imports.

$\mathbf{L_{exp}} = \mathbf{LR_d} Yx_{oecd}$ **……. (7)**
$\mathbf{K_{exp}} = \mathbf{KR_d} Yx_{oecd}$ **……. (8)**
$\mathbf{L_{imp}} = \mathbf{LR_d} Ym_{oecd}$ **……. (9)**
$\mathbf{K_{imp}} = \mathbf{KR_d} Ym_{oecd}$ **…… (10)**

Where L and K indicate sectoral labour and capital coefficients

The factor endowment hypothesis claims that a labour rich country will export labour intensive goods and import capital intensive goods. This can be indicated by the ratio of labour requirements of import and export which will be less than 1. Similarly the capital abundant country will export capital intensive goods and import labour intensive goods. The ratio of labour requirements of import and export will be greater than 1.

Foreign Direct Investment Model

Equation (2a) has been further modified to calculate the pollution content of FDI.

$\mathbf{F_{pd\ fdi}} = SR\ Y_{fdi\ (oecd)}$ -------- (11)

Where $Y_{fdi\ (oecd)}$ explains FDI from OECD

The model has further investigated how far FDI has induced export and in turn pollution. The pollution content of export due to FDI has been derived as follows:

$\mathbf{F_{pd}^{exp}{}_{(fdi)}} = S\ R_*\ Yx$ -------- (4*) where R_* denotes $(1-A_d^*)^{-1}$ and A_d^* defines input-output coefficient matrix including FDI as an input.

Data source

The following data sources have been used for the application of the model: 1) Input-Output table of Thailand for the years 1980, 1990 and 2000 (NESDB, 1984, 1994 and 2004); 2)

energy consumption data of Thailand (Department of Energy Development Programme, DEDP); 3) data on emissions using the Inter governmental Panel on Climate Change (IPCC) guideline; 4) data on trade with the OECD (OECD, 1986, 1992, and 2002) and the export and import price indices (Yearbook of International Trade Statistics, UN, 1984, 1992 and 2001); 5) exchange rate (International Financial Statistics); 6) labour and capital stock data (Report of the Labour Force Survey of Thailand, Report of the Manufacturing Industrial Survey of Thailand, National Statistical Office, various issues, and NESDB 2002); 7) data on foreign direct investment (Bank of Thailand, published and unpublished sources).

Pollution Haven Hypothesis and Thailand's Trade with the OECD

Results reveal an increasing trend of the PTOT indices from 1980 to 2000 for all the three pollutants (see Table 2.1). The values of PTOT are below 100 during the 1980s and 1990s. In contrast the values for 2000 are found to be above 100 for all the three pollutants. These findings seem to support or at least not to contradict the pollution haven hypothesis for Thailand in 2000. In other words Thailand's trade with the OECD has varying implications for the environment over the period 1980-2000. In the 1980s the environmental impact was moderate but with the passage of time its severity has increased and by the end of 2000 it has created unfavourable impact on the environment, turning Thailand into a pollution haven.

Analyses of the composition of the export and import sectors during the study period reveal a significant change. Thailand's major export in 1980 was food and food products with a 34.17% share. It went down to 9.97% in 2000. Agriculture's contribution to GDP went down from 25.4% in 1980 to 12.8% in 1990. Its exports declined. This decline was partly a result of falling prices, faltering world trade and competitors in the world rice market. In contrast, radio TV set communication equipment, industrial machinery and electrical and electronic appliances together captured the market sharing 21.55% in 1990 and 48.87% in 2000. These goods enjoy a favourable demand in international market. These figures reveal how Thailand has become an exporter of manufacturing goods to the OECD with the passage of time. They also reveal the declining role of agriculture. Another interesting feature observed in Thailand's trade with the OECD can be observed in the intra industry trade. For example, Thailand imports raw materials for electrical and electronic appliances the USA and Japan and exports the final product after they are assembled. For some industries, Thailand acts as a component supplier but assembling for final shape is provided by the developed country.

The composition of the imported commodities has not changed significantly. The major sectors are predominantly basic chemicals, radio TV set communication equipment, other transport equipment, electrical and electronic appliances, iron and steel industrial machinery.

The reason behind the high value of PTOT (more than 100) in 2000 is the high pollution generated from export intensive sectors. Why has the composition of the traded commodities changed? Why is Thailand exporting all pollution intensive goods at the cost of its environment? Are government policies not stringent enough? To address all these issues we

need to take a critical look at government policies especially relating to trade and the environment.

The first national economic development plan was launched in 1961 by the government of Thailand utilizing the import substitution (IS) regime to promote industrialization. The use of tariff was the major instrument that carved the country's development path and it effectively began in 1974 to promote domestic industry. In the mid 1980s, a shift in the trade policy of export promotion took place which reduced tariff. The maximum rate went down from 100 percent in the early 1990s to 30.24 per cent by the end of the 1990s.

To promote exports, the Thai government also adopted several measures (Bank of Thailand, Annual reports) especially after the 1980s. These included lifting of export quota, reduction in export duties on several commodities, business tax exemption, promotion of investment on manufacturing industries with strong export potentials such as automobile and parts, extension of export credit. The Thai economy changed its gear after the mid eighties. The boom was driven by the export of manufactured goods and services which grew almost six fold in six years. Major Japanese firms had transferred production processes to Thailand, in the latter half of the 1980s. Foreign investment into Thailand accelerated considerably from 1988 to 1990. The first stage of growth in the export industries was mostly focused in labour intensive and resource based industries. Textile firms from Japan and garments firms from Hong Kong and Taiwan had relocated production to Thailand and other overseas sites since the 1970s. These firms are highly pollution intensive. By the end of the decade, foreign investment had begun to change the export mix towards technology based products. Over half of the total export increased after the 1990s especially in technology based industries, e.g. automotive parts, computer parts and electrical goods. These goods are highly pollution intensive (Lucas et al., 1992). All the giant firms are setting up their industries in Thailand. By the late 1990s Thailand had become one of the world's largest assemblers of computer disk drives and emerged as a regional centre for auto manufacture. Thailand has always followed the strategy of **"**grow first clean up later**."**

The most proactive and ambitious trade policies of Thailand has aggressively pushed to increase its share of the world's export market by establishing a healthy collection of bilateral as well as regional free trade agreements (FTAs) with its trading partners. Thailand signed the GATT-WTO protocol concluding the Uruguay round. The development of NAFTA has had an impact on Thai trade patterns with the US. While Thailand has access to a larger market (US, Canada and Mexico), it also faces increased price competition from Mexico in some product lines. Another issue affecting Thai exports is the use of antidumping measures and countervailing duties on Thai products, as initiated by US producers and carried out by the US government. But US investment has brought in significant technology transfer which has created a great impact on Thailand's economy. Furthermore, a 'Free Trade Area' under an ASEAN framework was initiated by Thailand in June 1991 with the goal of integrating production structures toward improving ASEAN's export outlook in the world market.

The above trade strategies and policies relating to trade liberalization helped Thailand to diversify and boost export. However, this was not favourable for the environment. The

problem was aggravated by the industries' weak and non compliance of environmental regulations.

To combat the environmental deterioration from trade oriented growth, several environmental legislations were introduced in the past years. Most of the early laws were aimed at governing resource use rather than conserving them. The first environmental protection legislation was passed in 1975. However a more comprehensive environmental legislation in Thailand is the 1992 Enhancement and Conservation of National Environmental Quality Act (NEQA). Another important legal instrument is the 1992 Factories Act which regulates waste discharge from the industrial plants. Another act, the 1992 Hazardous Substances Act, controls the production, import and export, or possession of hazardous substances that could become hazardous waste in the future.

The existing regulatory command-and-control regime, a major source of debate, is slowly being replaced by the introduction of market-based instruments. In addition, direct pressure from many Thai communities affected by pollution is moving the government and the private sector to improve their compliance with environmental regulations.

In spite of all these efforts implementation of regulations has been far below expectations. Lack of enforcement is a basic problem in Thailand. The policies, rules and organizations created to protect the environment are not effective. One of Thailand's major strategies has been to encourage the private sector to play a key role in the economy. But the private sector does not always support and promote environmental quality by adopting environmentally friendly production processes (TDRI, 2000). Moreover there is no suitable Environmental Tax. Thailand proceeded to apply tax measures to control pollution in May 1997. Thus, "to date Thailand has had the least success in reducing industrial pollution and improving ambient environmental quality" (Rock, 2002). Lax environmental regulations and non-compliance have thus distorted the pattern of comparative advantages in Thailand. Differences in cost of complying with environmental regulations between Thailand and the OECD have helped the OECD countries to relocate industries in Thailand thus pushing Thailand towards being a pollution haven.

It should be noted that differences in pollution policy are only one of many factors that cause trade. There may be other motives for trade that can change these results.

The Factor Endowment Hypothesis and Thailand's Trade with the OECD

Estimates of capital and labour requirements (1980, 1990 and 2000) to produce one thousand baht worth of exports and imports show that Thailand's export required more capital (more capital per worker) than imports in 2000 (See Table 2.2). More specifically Thailand's import is 5% less capital intensive than its exports. In contrast, Thailand's imports were 33% and 20% more capital intensive than its exports in 1980 and 1990 respectively. According to the theory of factor abundance, Thailand as a developing economy is supposed to export labour intensive goods and import capital intensive ones. Thailand is exporting capital intensive

goods in 2000. Thus our evidence does not provide support for the FEH in 2000 while it does for 1980 and 1990.

The shift of exports from agriculture to manufacturing and from manufacturing to the emerging groups is one of the most important reasons for the change in production technology, i.e. from labour intensive to capital intensive. Table 2.3 shows that Thailand has shifted its export economy from labour intensity to capital intensity. The scarcity of skilled labour has also been responsible (BOT, Annual Reports) for this shift.

The transfer of technology that accompanied huge foreign investment started coming from the OECD countries (especially Japan and USA). Industries which were set up after the 1990s were generally large scale and capital intensive with less employment generation. This change explains why in 2000 Thailand's export is more capital intensive.

So far the study has focused on the impacts of liberalized trade on the environment considering two hypotheses, namely, pollution haven and factor endowment. But the impact of trade flows on the environment can also be influenced by another factor, which is foreign direct investment.

Foreign Direct Investment and its Impact on the Environment

Throughout the past four decades, Thailand has been a significant recipient of FDI. Foreign direct inflows of investment to Thailand boomed in 1995-2000. It increased from around US$ 515 million during the period of 1970-75 to over US$ 17416 million during the period of 1996-2000. The biggest share of the total FDI mainly flows to the manufacturing sector. Moreover, an important proportion of FDI has been from the OECD countries (67.79% in 1987 increased to 75.69% in 2000). Japan was the major player in FDI in Thailand in the years prior to the crisis. Japanese major investment was on electrical appliances, machinery and transport equipment throughout the 1990s. Along with Japan, the USA and the EU are also important sources of FDI. There are several reasons why investing in Thailand is attractive: macro economic stability, rapid expansion of the domestic market (GNP growth more than 6% during the period 1985-95), low labour cost providing a platform for exports and baht devaluation in 1984. The major receiving sector of OECD investment is industry whose share has increased from 52.7% in 1990 to 62.6% in 2000. Electrical and electronic appliances, machineries and chemicals deserve mention. Our earlier analysis has clearly indicated that there has been a dramatic change in the composition of exports from agro based to manufacturing over the period 1980 to 2000 which has closely mirrored the shift in the domestic trade policy (Kohpaiboon, 2003). This has created a favourable climate for migration of dirty industries from OECD. And FDI has played an important role in this shift. The environmental implications of FDI must be considered too, especially since they have been studied less.

It has already been observed that the pollution embodied in the export sectors is quite high which has moved Thailand to being a pollution haven in 2000. The study has also attempted to compute the pollution content of FDI from the OECD countries following the equation (11). The results are 428.49KtC, 3.54KtS and 4.07 KtNOx for CO_2, SO_2 and NOx respectively.

Moreover, foreign direct investment can be treated as an input in the economy to enhance its productive capacity. This has been modelled in equation (4*). Computations show that the pollution content of exports fuelled by FDI is 343.14 KtC for CO_2, 3.09 KtS for SO2 and 3.06KtNOx for NOx. These values clearly indicate the high contribution of FDI (more than 80%) to the generation of pollution.

Conclusion and Policy Options

The complex interrelationship between trade and the environment has become a focal point for international as well as national policy makers. The findings of this study explain why pollution haven matters for Thailand and factor endowment does not. The results indicate that Thailand is a pollution haven and does not support the factor endowment hypothesis in 2000. Thus, the PHH is in conflict with the FEH or at least not in conformity with the FEH. Furthermore, the effect of FDI on the environment has not been environment friendly.

From the current study we can suggest several policies involving trade and the environment. The Thai government should pay more attention to the environmental quality of exported goods. This will create sustainable trade development in the future since the country's economy is more dependent on export. Greener trade should be given continuous preference by the government.

a) Instead of too much emphasis on the export of capital intensive goods, a balanced export strategy combining labour and capital intensive goods may be sought.

b) To maintain environmental quality, taxes or tariffs based on the environmental impact of the production of the goods, such as eco-duties, energy tax and other economic instruments (for example fuel user charge, emission charge, and pollution management fee) might be implemented.

c) The technological improvement in producing green products would require more R&D expenditure. To encourage that government can provide financial incentives in the form of tax rebate/exemption to green industries and also think of providing subsidies to the users of imported technology necessary for the production of green products.

d) Last but not least the Thai government should adopt a more proactive stance towards foreign environmental regulations affecting Thai producers. Stricter standards are in the

offing. An early action of the government would be helpful to the firms to adjust to external regulations.

The study suggests that the Thai government should integrate both trade and environmental policies in a coherent manner (trade related environmental measures, TREM and environment related trade measures, ERTM) to achieve the objectives of gains from trade while protecting the environment.

TABLES

Table 2.1: Pollution terms of trade of Thailand with OECD for CO_2, SO_2 and NOx emission during 1980 to 2000 (KtC: *Kilo ton carbon*, KtS: *Kilo ton Sulphur* and KtNOx: *Kilo ton Nitrogen oxide*)

Emission	**CO_2**			**SO_2**			**NOx**		
	1980	**1990**	**2000**	**1980**	**1990**	**2000**	**1980**	**1990**	**2000**
Pollution embodied in exports (*KtC, KtS,KtNOx***)**	4120.11	2711.49	8579.35	41.55	26.14	83.11	9.13	11.76	35.47
Pollution embodied in imports(*KtC, KtS, KtNOx* **)**	8433.57	3014.48	5573.96	82.79	27.29	50.72	19.58	19.87	35.34
Pollution terms of trade	0.4885	0.8994	1.5392	0.5018	0.95786	1.6384	0.4664	0.5917	1.0039
Pollution terms of trade*100	48.85	89.94	153.92	50.18	95.78	163.84	46.64	59.17	100.39

Table 2.2: Capital and Labour requirements in exports and imports during 1980 to 2000

	1980		**1990**		**2000**	
	Capital requirements per thousand Thai baht of output	**Labour requirements per thousand Thai baht of output**	**Capital requirements per thousand Thai baht of output**	**Labour requirements per thousand Thai baht of output**	**Capital requirements per thousand Thai baht of output**	**Labour requirements per thousand Thai baht of output**
Exports	Akx= 189003680.5	Alx= 1321655.8	Akx= 780161741.8	Alx= 1872121.8	Akx= 1713874498.0	Alx= 1792523.8
Imports	Akm= 273144212.6	Alm= 1432131.2	Akm= 530122021.1	Alm= 1057617.2	Akm =1165240358.1	Alm= 1272383.7

1980	**1990**	**2000**
K_x = Akx/Alx = 143.005	K_x = Akx/Alx = 416.725	Kx = Akx/Alx = 956.1236
K_m =Akm/Alm = 190.725	K_m =Akm/Alm = 501.241	Km =Akm/Alm = 915.793
$K_m = 1.33\ K_x$	**$K_m = 1.20K_x$**	**Km = 0.95 Kx**

Table 2.3: Labour and capital intensiveness in share of exports

Exports(share of total)	1981-85	1986-90	1991-95	1996-2000
Labor share	15.7	27.8	25.9	16.7
Capital share (technology based)	7.0	20.9	39.9	54.2

Source: Bank of Thailand, Annual Report (Various issues)

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