ECON 610: DEVELOPMENT ECONMICS TERM PAPER SERIES

Balancing Economic Development and Environmental Protection in Developing Asia

(Draft Version – Not to be Quoted)

Sunil Malla
Graduate Student
Department of Economics
University of Hawaii-Manoa
Honolulu, Hawaii

November 1999

Balancing Economic Development and Environmental Protection in Developing Asia [1]

Abstract: The relationship between economic development and environmental protection has received a lot of attention in recent decades and investigating this relationship is an essential step in delineating possibilities and plans for "sustainable development". Balancing of economic development and environmental protection in developing countries require a increasing of economic activity – not towards producing less, but producing differently. Policies for economic sectors must take the environment into account and the flexible, market-based approach should be applied to its environmental management. Essential elements of such a strategy (as explained in the policy matrix) will, therefore, include economic policy reform at both micro and macro levels, classification and enforcement of property rights; specifically targeted government policies and regulations to discourage environmentally destructive behaviors and encourage environmental protection or enhancing activities; a greater reliance on efficient, market oriented measures; and a commitment to institutional, participatory capacity building in developing countries.

[1] I am grateful to Prof. Chung H. Lee, Department of Economics, University of Hawaii, for his valuable comments and suggestions at various stages. This paper is part of the requirement of Development Economics (ECON 610) graduate level course taught by Prof. Lee.

I. Introduction

The relationship between economic development and environmental protection has received a lot of attention in recent decades and investigating this relationship is an essential step in delineating possibilities and plans for "sustainable development". Development polices have traditionally been thought to promote economic well-being, while environmental policies have been seen as restricting it. The Club of Rome's report on the predicament of mankind published in 1972 and titled *"The Limit of Growth",* argued that because of finite limits to the earth's physical carrying capacity, rates of economic growth should be deliberately restricted. However, in recent years, development policymakers recognized that countries imposing high environmental standards spur research in pollution abatement, develop human capital, and increase growth. The World Bank's report *Development and the Environment* (1992) and *UN Conference on Environment and Development* (UNCED) at Rio (1992) emphasize that care for the biosphere will require economic growth and that growth cannot take place in a deteriorating environment. Similarly, environmentalists are coming to understand that answers to many problems, especially those that afflict developing country populations, lie in faster – not slower – development along with sound environmental policies.

If a simple proportional relationship between emissions and output is assumed, like for example in early models of pollution accumulation, then, without policy interventions, there is an underlying strictly increasing relation between pollution and gross domestic product (GDP). However, the pollution process is complex, largely affected by society's awareness regarding the preservation of environmental resources. This of course leads to the formulation and application of policies that change the pattern of pollution both within a country and across the globe. Such policies could lead to direct restriction of polluting activities, introduction of clean technologies that reduce emissions per unit of output, or relocation of polluting activities in countries with more lax pollution controls. The "Earth Summit" signaled the resolve of the international community to move beyond efforts to integrate the goals of environment and development, to the implementation of integrated polices and the alignment of actions with agreed principle. Additionally, "Agenda 21" – UNCED's blueprint for sustainable development – notes that unregulated economic growth can have profound and sometimes irreversible effects on the environment. These negative impacts need to be addressed by specifically targeted policies, strengthened environmental institutions and increased allocation of funds for investments in environmental technologies.

In many developing countries of Asia[2], however, concern about pollution or degradation is simply not a priority; even if it did, there is lack of institutional capacity to implement its environmental policy. Such environmental degradation can impose large costs on the economy and on society if

[2] See Table 1 for indicators of economy and environmental quality in selected Asian countries.

proper measures are not taken.[3] Balancing of economic development and environmental protection in developing countries require a increasing of economic activity – not towards producing less, but producing differently. Policies for economic sectors must take the environment into account and the flexible, market-based approach should be applied to its environmental management.

This paper focuses on relationship between economic growth and environmental protection and suggests possible future direction towards sustainable development in developing countries of Asia. The remainder of this paper is organized as follows. Section II provides the summary of the recent development on relationship between economic growth and environment. Section III briefly discusses the social impacts of recent Asian crisis. Section IV highlights economic policies of environmental pollution and Section V explains political economy of environment. Section VI concludes.

[3] For example, the economic costs of environmental degradation in P. R. of China in 1990 alone was 3.8-7.3 per cent of their *GNP (Smil, 1996)*. It is estimated that the environment related funding needed for the Asia and the Pacific region is roughly 245 billion US dollars for the year 2025 with average annual growth rate of 7.2 per cent *(ADB, 1997).*

Table 1. Economy and Environmental Indicators for Selected Asian Developing Countries[a]

Countries	Average Annual GDP Growth Rate		Export of Goods & Nonfactor Services as %of GDP		Average Annual Growth Rate of Imports		Average Annual Rate of Deforestation ('000 sq. km)	Net Energy Imports as % of Energy Consumption	Carbon Dioxide Emissions[b] 1992	
	1980-90	1990-95	1980	1990	1980-90	1990-95	1980-90	1994	Total	Per Capita
Nepal	4.6	5.1	1.1	25.8	4.9	6.8	0.5	88	1.5	0.1
Bangladesh	4.3	4.1	7.7	14.2	1.8	5.3	0.4	28	20.9	0.2
Viet Nam	…	8.3	…	…	…	…	1.5	-55	31.7	0.4
Mongolia	5.5	-3.3	3.1	12.8	…	…	1.3	15	8.5	3.4
India	5.8	4.6	5.9	12.5	4.5	2.7	3.4	21	908.7	1.0
Lao, PDR	…	6.5	…	5.9	…	…	1.3	-18	0.3	0.1
Pakistan	6.3	4.6	8.1	7.7	2.1	10.3	0.8	40	85.4	0.6
China, PR	10.2	12.8	11.5	15.6	10.0	24.8	8.8	-1	3,192	2.7
Sri Lanka	4.2	4.8	6.8	11.0	2.0	15.0	0.3	80	5.9	0.3
Myanmar	0.6	5.7	1.9	16.3	-7.0	38.7	4.0	…	7.0	0.1
Indonesia	6.1	7.6	2.9	10.8	1.2	9.1	12.1	-120	296.1	1.5
Philippines	1.0	2.3	3.5	9.4	2.4	15.2	3.2	71	61.2	0.9
Thailand	7.6	8.4	3.3	14.2	12.1	12.7	5.2	87	175.0	3.0
Malaysia	5.2	8.7	14.0	14.4	6.0	15.7	4.0	-71	106.6	5.3
South Korea	9.4	7.2	12.0	13.4	…	7.7	0.1	86	373.6	8.3
Hong Kong	6.9	5.6	14.4	13.5	11.0	15.8	0.0	100	29.0	5.0
Singapore	6.4	8.7	10.0	…	8.6	12.1	0.0	100	63.7	19.1

a. Countries are in ascending order of per capita income. Source: World Bank (1997)
b. Total CO_2 is in million metric tons and Per Capita CO_2 is in metric tons. Source: WRI (1998)
c. Total SO_2 is thousand metric tons and Per Capita SO_2 is in kilograms. Source: Shrestha, Bhattacharya and Malla (1996).

II. Economic Growth and Environment

Economy and the natural environment inter-linkages are all embracing and dynamic in nature. Every economic action can have some effect on the environment, and every environmental change can have an impact on the economy. In Figure 1, we simplify economy into two sectors: production and consumption.

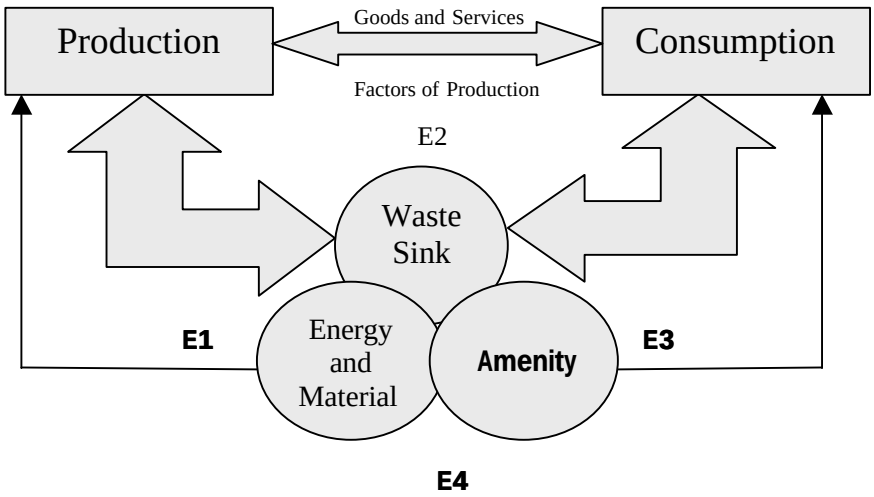

Fig.1: Interaction of Economy and Environment

Exchanges of goods and services and factor of production take place between these two sectors. The environment is shown here in two ways: as the three inter-linked circles E1, E2 and E3; and the all-encompassing boundary labeled E4. The production sector extracts energy resources (such as fossil fuels) and materials resources (such as iron ore) from the environment. These are transformed into outputs; some useful (goods and services supplied to consumers) and some which are waste products, such as air pollutants. The environment's first role, then, is as a supplier of resources. Its second is as a sink, or receptor, for waste products. The environment acts as a waste sink, as a partial recycle factory for human wastes from production and consumption and as source of energy and material resources. The next role to be considered is that marked E3 in the figure. The environment acts as a supplier of amenity, educational and spiritual values to society.

2.1 Growth Theories and Asia

The sources of economic growth have been much debated in recent years within the economics profession. This paper concentrates on three broad models that attempt to account of differences in economic growth and living standards across countries.

The classical theory of economic growth follows Adam Smith in emphasizing that high levels of national income depend on the division of labor within an economy, as well as the division of labor between the national economy and the rest of the world. As Smith emphasized, market-based trade allows an economy to reap the benefits of labor specialization. The gains from specialization depend especially on low transaction costs in domestic and international trade. Thus Smith and many researchers after him highlighted the following factors as ingredients of rapid growth: open international trade, low transport costs, and well-functioning markets in which property rights are well protected and contracts can be enforced at reasonable cost.

The neoclassical theory of economic growth is based on the important contribution of Robert Solow (1956), and emphasizes that economic growth depends on capital accumulation. The neoclassical theory attribute rising income per person to a rising stock of capital per person. While the theory originally stressed the rising stock of physical capital (building and equipment), it has long since been extended to include the accumulation of human capital (schooling, and on-the-job training). As economic growth proceeds, the ratio of capital to labor rises in the economy until steady-state level is reached. Neoclassical theory predicts that the rise in the capital stock per worker is associated with a fall in the rate of return to capital. As an economy becomes richer, the returns to new investments diminish. The theory assumes that poor countries differ from rich countries mainly because they start out with lower stocks of capital per person. As a result of this capital scarcity, the rate of return to capital should be higher. Poorer countries should therefore grow more rapidly than richer countries because they have a higher return to investment, and because the proportional growth of the capital stock is faster. Poorer countries also have another route to faster growth. They can borrow and adapt technology and production techniques from richer countries without paying the full costs of research and development.

Poorer countries also have another route to faster growth. They can borrow and adapt technology and production techniques from richer countries without paying the full costs of research and development. Similarly, poorer countries can learn from the richer countries' successes and mistakes. They can copy good (or bad) ways to manage factories, organize institutions, and run economies. Alexander Gerschenkron referred to potential of this kind as "the advantages of backwardness" (Gerschenkron, 1962).

Endogenous growth theory stresses new ideas and new products as the engine of long-term growth, rather than capital accumulation. Following Romer (1986); Lucas (1988); and Grossman et al. (1991), endogenous growth theory focuses on the economy's human resources (such as scientists and engineers) and on specific institutions (such as patent laws) that give rise to technological innovations, and thus to improved living standards. Unlike neoclassical assumption about a decline in

the rate of return to investments, endogenous growth models stress that investments in knowledge might have a constant, or even rising, rate of return. The theory assumes that new knowledge opens the way for further breakthroughs rather than exhausting the opportunities for new ideas. Thus according to this model, rich countries could grow just as faster than poor countries.

In summary, these three approaches make quite different predictions about economic prosperity and growth across countries. The classical theory suggests that poor countries may be poor as a result of policies and institutions that inhibit the division of labor in the society. Also, landlocked countries or countries far away from major market economies are less able to benefit from the global division of labor. The neoclassical theory, in contrast, argues that high saving and investment rates, combined with a low initial level of capital per worker, are the key to rapid growth. As the neoclassical theory pays little heed to natural differences in geography or technology across countries, it is rather optimistic that poorer countries will catch up with richer countries through faster capital accumulation. For poorer countries, the endogenous growth theory is probably most problematic. It suggests that if rich countries are ahead of poor countries because of a higher stock of knowledge, they might well be able to maintain or widen their lead, because a higher knowledge base in rich countries is likely to generate even more innovations in the future.

Naturally, the general debate about sources of economic growth has spilled over into the debate about Asia. Until "pre-Asian Crisis era", the evidence from empirical analysis,[4] best supports a synthesis of the classical and neoclassical approaches, augmented by demographic considerations. East Asia has benefited from rapid capital accumulation (as the neoclassical approach would suggest), an increasingly sophisticated internal and international division of labor supported by good policies and institutions (as the classical approach implies), and a demographic transition. These findings suggest that most of Asia has the potential for rapid growth in the future and can further narrow the gap with richer economies. Nonetheless, as the countries reach higher income levels, economic growth will gradually slow down as the ratio of capital to labor rises and rates of return to new investment declines. An aging of the population will reinforce this tendency for growth to slow. However, the predictions of endogenous growth theory do not seem to apply. While Asia has accomplished important technological advances, most of the rapid growth has come through capital accumulation. But authors warn that the empirical analysis from these cross-country models should be seen as a useful first step towards understanding the determinants of growth, not a complete explanation.

[4] For details, see Barro, 1991; Barro and Lee, 1994; Barro and Sala-I-Martin, 1992; Mankiw et al., 1992; Sala-I-Martin, 1996; Sachs and Warner, 1995; and Radelet et al., 1996.

2.2 Economic Growth and Environment: A Complex Relationship

Neoclassical growth models have been used extensively to examine the link between environmental degradation and economic growth (for survey of earlier works, see Barrett, 1992; and John and Pecchenino, 1994). Generally, the presence of environmental externalities results in lower consumption and lower physical capital accumulation when pollution is optimally controlled. However, using these models to develop policy guidelines which align the decentralized with the efficient path is problematic, as growth paths in the neoclassical models are not affected by policy variables (Byrne, 1997). Recent advances in endogenous growth theory do provide a policy link for affecting growth rates. These models have only recently begun to be exploited for analyzing environmental questions (Johns and Manuelli, 1995; and Mohtadi, 1996). Since it is necessary that government intervention is necessary for addressing environmental externalities, environmental issues are usefully modeled in an endogenous growth framework where policy prescriptions affecting the balanced growth path are available.

Based on a simple three sector model where labor can be allocated to manufacturing (which is pollution increasing), technology accumulation (pollution neutral), or emission abatement (pollution reducing) and capital can be used in activities which are pollution increasing (manufacturing) or pollution decreasing (abatement), Byrne, 1997 suggested that pollution is not directly linked to economic growth and thus economic and pollution growth rates need not have a one to one correspondence. In other words, a positive level of steady-state growth can be achieved while environmental quality is maintained or improved, since optimal pollution growth may be positive, zero, or negative. Since the evolution of environmental degradation is of critical importance to the results of these models, and environmental problems are likely to have a wide variety of appropriate representations, generalizing from any one analysis must be avoided. Careful identification and specification of the relevant environmental – economic interaction is essential for developing appropriate policies to promote economic growth while maintaining environmental quality.

As much of Asia's environmental degradation took place and accelerated during the region's rapid economic growth of the past 30 years, a reasonable question is whether growth has been its main cause. Do higher income levels imply a worse environment? Several researchers (Grossman and Krueger, 1993, 1995; and Shafik, 1994) suggest an empirical inverted-U relationship between various air and water pollutants and per capita GDP. These results can be interpreted as evidence of the existence of an environmental Kuznets curve for these pollutants. Selden and Song (1994) also found that the per capita emissions of certain air pollutants exhibit an inverted-U relationship with per capita GDP. A theoretical basis for the inverted-U curve for pollution is also provided by Seldon and Song (1995). Figure 2 provides a relationship between income and the environment that displays an

inverted U-shaped pattern known as the environmental Kuznets curve. This relationship implies that as a country gets richer, its environment will get worse before it gets better.

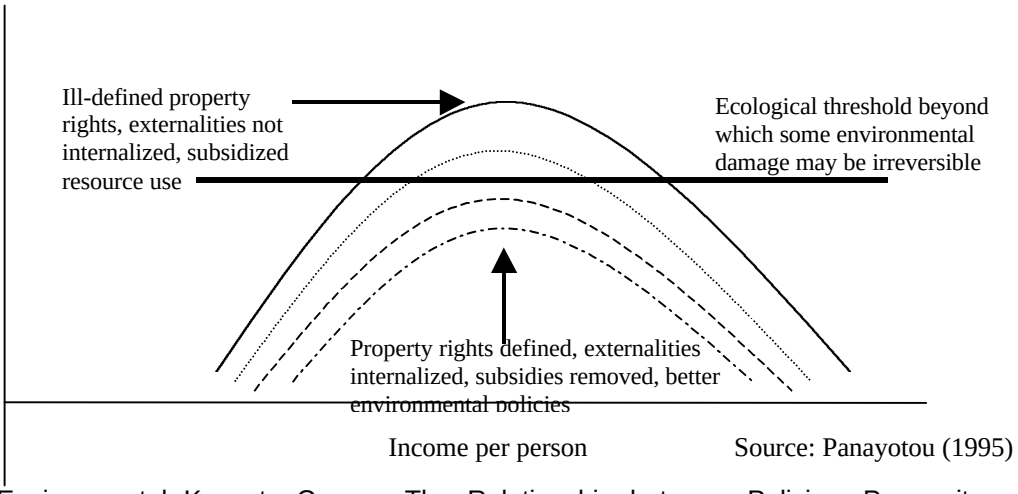

Fig.2: The Environmental Kuznets Curves: The Relationship between Policies, Prosperity, and Environmental Damage

The logic behind this observation is as follows. As economic development accelerates, agriculture becomes more intensive, resource extraction increases, and industrialization takes off; thus the rates of natural resource depletion begin to increase, and the quantity and toxicity of waste rise. Eventually, as economies become richer still, their economic structure shifts toward industries and services that use natural resources less intensively. Greater prosperity brings with it increased environmental awareness and a willingness and capacity to pay for a cleaner environment. As a result, countries enforce environmental regulations more strictly and spend more money on the environment. Subsequently, environmental degradation levels off and gradually declines.

Casual observation suggests that this relationship applies to the urban as well as the rural environment. For example, the cities of the newly industrializing countries, such as Bangkok, Seoul, and Shanghai are far more polluted than they were 20 or 30 years ago, and their pollution levels are rising at rates that match or exceed their rates of economic growth. Conversely, cities in the industrial countries are cleaner today than they were 20 or 30 years ago.

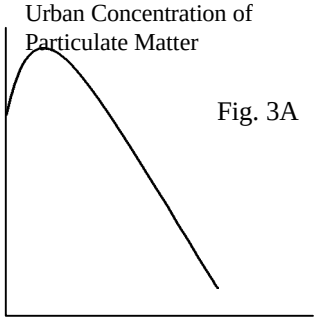

Fig. 3A

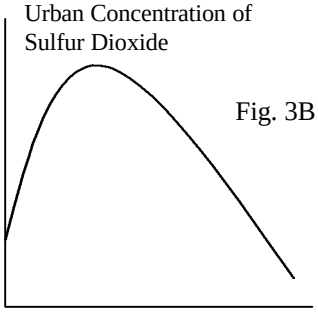

Fig. 3B

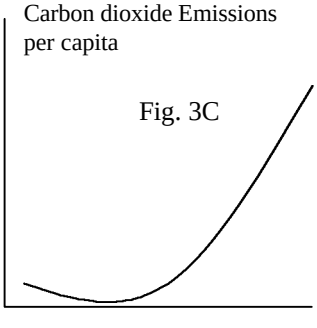

Fig. 3C

Fig. 3: Environmental Indicators at different income levels.

The empirical analysis on relationship between the environment and growth showed that for some pollutants, Asia does indeed exhibit and inverted U-shaped relationship between environmental degradation and income, i.e., environmental degradation first rises and then falls as income per person increases. These pollutants include sulfur dioxide, particulates in cities, and arsenic in rivers. The turning point at which the ambient levels of these pollutants begin to fall is an annual income per person of $5,000 to $7,000 (on PPP basis) (Islam, 1996). Panayotou (1995) obtained similar results for deforestation rates for a sample of tropical countries dominated by Asian countries. The turning point, however, was at much lower level of annual income per person: approximately $1,000 (on ppp basis). These findings suggest that during the next 20 or 30 years, environment quality will improve slowly in East Asia and in the higher income countries of Southeast Asia, such as Malaysia, and will continue to deteriorate in South Asia and the lower-income countries of Southeast Asia.

Figure 3 provides the environmental indicators at different income levels. For certain pollutants environmental problems initially worsen but then improve as incomes rises (Figures 3.A and B), while some problem continue to worsen (Figure 3.C). Some pollutants such as sulfur dioxide, heavy particles, and arsenic in rivers, appear to be important differences in the income-environment relationship between Asia and the rest of the world. In Asia certain types of pollution tend to rise more rapidly with higher income than do elsewhere, but they also begin to fall more quickly. Higher initial population density together with more rapid industrialization may account for the rapid rise, while increased environmental awareness and the availability of new abatement technology permit pollution to be reduced at relatively lower income levels.

While this result provides grounds for optimism, it raises a question, namely, are these observed relationships between income and the environment inevitable? Must a worsening environment always accompany economic growth or can the environmental Kuznets curve be flattened? Substantial evidence exits that it can be. In the presence of policy distortions or policy failures the environment deteriorates more at low income levels than in their absence. Similarly, the improvement of the environment with income growth at higher income levels is not automatic, but depends on the policies and institutions in place.

Overall, the results from these studies suggest that there is no simple proportional relationship between economy and the environment. There exists evidence of linkage between the

economy in general with significant changes in the environment. In addition, there is evidence that differences in abatement costs are a significant determinant of economic growth. There is, however, evidence that increases in income will, after a point, lead to lower concentrations of some pollutants.

III Social Impacts of Asian Crisis

The Asian crisis began with a financial panic that eventually led to marked contractions in GDP and employment in the affected economies. GDP shrinkage in 1998 ranged from nearly 14 per cent in Indonesia to 0.5 per cent in the Philippines. In turn, these have resulted in adverse social consequences. Although there are sings that the worst of the financial crisis is over and the crisis economies are getting on the road to recovery, the social impacts continue to unfold. The social crisis is likely to be deeper and can be expected to persist long after the "crisis economies" return to solid growth. There is danger, therefore, that improving economic conditions may lull observers into thinking that social conditions have recovered when they may in fact be worsening. Table 2 provides the summary of a study that assesses the social impact of the crisis. However, as environment is the main focus of this paper, it will be given a special emphasis below.

Table 2: The Social Impacts of the Asian Crisis

PRICES AND ASSETS	INCREASE ON THE PRICES OF IMPORTED GOODS AND SERVICES. IMPACT OF INFLATION WAS HARSHER ON THE POOR. REDUCTION ON THE REAL VALUE OF HOUSEHOLD SECTORS.
Employment and Income	Increase in unemployment (especially manufacturing and construction sectors). Decrease in real earnings. Fall in rental income and profits and other forms of business income.
Inequality and Poverty	Increase in income inequality and poverty. Change in intra-country regional distribution of income.
Education	Education budget cuts. Reduction in school enrolments.
Health and Family Planning	Decline in public health budgets and facilities in real terms. Increase in use of contraceptives.
Social Capital	Flourish in community-based initiatives. Increase in crime rates.
Especially Disadvantaged Groups	Poor have suffered more because of their low income and education with fewer options for coping with the crisis. Harm to overseas migrants working in other Asian countries. Urban population have been more adversely affected.

Source: Knowles, J.C. et al. (1999)

Even before the crisis, an estimated full cost valuation of all pollution in large Asian cities is 5-10 per cent of GDP, while the cost of cleanup is estimated to be only about 2-3 per cent of GDP

(World Bank, 1992; and Brandon, 1994). Yet as Table 3 indicates, no government is spending at the levels needed, and individual enterprises do not on their own have the incentives to internalize costs and thus reduce resource use and waste production. Actual spending has decreasing significantly in several countries over the past two years, primarily due to the crisis.[5] It is clear that whether considering finance, personnel, or political will, government cannot manage the environment alone.

Table 3: Government Spending on Environmental Infrastructure and Services

Sub-Region/Country	% Share of GDP Spent by Government on the Environment (1997)
East Asia	
Japan	1.8
China	Less than 0.5
Taiwan	1.0
South Korea	1.3
South-East Asia	
Indonesia	Less than 0.5
Malaysia	0.9
Singapore	1.2
Philippines	0.5
Thailand	0.8
Vietnam	0.1

Source: AET (1999)

Government budgets for the environmental protection have been declined further in Thailand, Korea, and Malaysia since the onset of the crisis, and probably also in the other crisis countries. People's intense quest for additional income during the crisis has placed strains on forest, fishing, and water resources in most of the crisis countries. The recent collapse and uncertain recovery of major Asian economies has accentuated the need for new approaches towards environmental management. Although, many casual observers have noted reduction in air pollution in capital cities owing to fewer vehicles on the road, the only country study reporting official levels (in Seoul) suggests that there has been not departure from the previous trends (Moon et al., 1999). Likewise, contrary to some expectations, the downturn in industrial production due to contracted markets has not led to diminishing levels of industrial pollution, but, as revealed in the case of Indonesia, has instead seen a rise of about 15 per cent (Asfah 1998). The reasons are the most troubling: the lower regulatory capacities of financially strapped, downsized governments have allowed producers to dump untreated wastes and pollute the air with less fear of being caught or subject to sanctions. These trends are taking place in a context of dramatically increased levels of poverty and unemployment, greatly reduced spending on environmental infrastructure, and a general diversion of attention away from environment management. In assessing the impacts of the economic reversals, Asfah (1998)

[5] For example, Thailand's government's expenditure on environmental programs decreased by 27 per cent for 1999 as compared with 1997 (Kittiprapas, 1999).

concludes “effective policies will require increased reliance on community and market incentives and voluntary programs to control pollution”.

The current economic crisis, however, is only a transient event. The critical question for the environment is whether growth will resume in the context of fundamental reforms. The environmental problems associated with the crisis can not be as easily and directly managed as economic problems; solutions involve building regulatory, institutional, technical and managerial capacity over time. The short term policy responses should include a) ensuring that food markets work, b) sustaining purchasing power of poor households, c) targeting geographical areas, d) promoting public employment and local infrastructure, and e) providing direct food support, especially where markets are breaking down. In medium term, governments should air to protect social capital, improve local financial intermediation, reform labor market policies, and establish environmental law and regulations. It will be interesting to carry out the further research on change in the quality of the environment will take place in next few years in Asia.

IV Economic Policies of Environmental Pollution

Economic evaluation of policy towards environmental pollution seeks to determine how much abatement of emissions of different pollutants is socially efficient. Economists have approached the problem of pollution abatement in two ways. First, most analyses have concentrated on the development of economic models of the cost of reducing emissions (Mann and Richels, 1992). Second, direct estimates of damages against calculated abatement costs to determine whether abatement is efficient on economic grounds (Nordhaus, 1993).

Table 4 provides a summary view of the alternative approaches to pollution abatement policy evaluation, incorporating the dominant patterns of views among three communities: scientists; engineering- technological experts; and economists. Two principle alternative approaches, namely, "engineering" approach (i.e. "bottom-up" modeling) and economic cost approach (i.e. "top-down" modeling), are commonly used to calculate the abatement costs. While bottom-up analysis treats the structure of the economy and performance of technologies in a detailed fashion, top-down analysis aggregates such data into a macroeconomics framework *(Wilson and Swisher, 1993).* In the top-down models, the most important parameters are GDP, costs and prices, and parameters such as price and income elasticities, that describe the overall energy-economy interactions. The conflicting views and approaches between top-down and bottom-up analyses stem from the fact that the analysts are asking different questions, based on their different perceptions of reality. Bottom-up models seems to top-down analysts to be inherently normative, because they assume that existing market failures and institutional barriers will be removed. On the other hand, top-down models are structured to preclude asking what bottom-up analysts see as the key policy questions, such as "which barriers should be removed and how?" However, at least in principle, the two approaches should be complementary.

The enumerative approach (used by Nordhaus, 1993; William, 1992; Fankhauser, 1992; and Titus, 1992) identifies specific areas of pollution impact (for e.g. on agriculture), and attempts to estimate an economic evaluation of the damage in each category. In the second approach, there is no attempt to quantify damages from pollution in economic terms. Instead, the effects of pollution, in particular, global warming, especially in the ecological sphere, are considered either potentially catastrophic, thereby requiring preventive action; or they are viewed as minimal and insufficient to warrant abatement, in part because the prospective extent of warming is seen to be very limited.

Table 4: Overview of the Alternative Approaches to Environment Policy Evaluation

	Abatement Costs		
	Approach	Bottom-up approach	Top-down approach (most economists)
Environmental damage	Enumerative Approach	Low abatement costs; modest environment damage: ↓ ACT	Moderate abatement cost; Environment damage: 1. At a high discount rate, with a low expectation of long-term warming: ↓ MINIMAL ACTION (Nordhaus) 2. At a low discount rate, with a low expectation of long-term warming: ↓ AGGRESSIVE ACTION (William)
	Catastrophic approach (most scientists)	Low abatement costs; risk of catastrophe assumed to be: 1. Significant: ↓ ACT 2. Negligible: ↓ DO NOT ACT	Moderate abatement cost; some risk of catastrophe: ↓ "HEDGE" (some action; wait for confirmation before tracking major action-Manne and Richels; Schelling)

4.1 Environmental Policy Matrix

The new post Rio emphasis on reconciling environment and development, incorporating poverty and equity issues, and managing the global commons has built the momentum for environmental policy innovations. Taking stock of the various policy instruments being used for sustainable development requires some organizing principles which are set out in the "policy matrix" as suggested the World Bank (See Table 5). The matrix distinguishes between policy approaches that are aimed at natural resource management as compared with pollution prevention and mitigation, and it organizes the approaches themselves into four broad categories depending on the principal emphasis of each policy instrument:

Table 5: Environmental Policy Matrix

Approaches/policy Instruments		Resource Management				Pollution Control			
		Sectors*				Sectors**			
		I	II	--	N	I	II	--	N
Using Markets	Subsidy Reduction								
	Environmental Taxes on emissions, inputs and products								

	User fees for natural resources and services								
	Performance bonds/deposit reform								
	Targeted subsidies								
Creating Markets	Property rights/Decentralization								
	Tradable permits/rights								
	International offset systems								
Regulating	Standards								
	Bans								
	Quotas								
Engaging the Public	Information disclosure								
	Public participants								

*. Sectors in Resource Management include: water resources, fisheries, land management, forests, sustainable agriculture, mineral resources etc.
**. Sectors in Pollution Control include: air pollution, water pollution, solid wastes, hazardous waste/toxic chemicals etc.

Using Markets: Among the most powerful policies for improved environmental management are those that use the market and price signals to make the appropriate allocation of resources. Environmental resources are typically under priced in two important ways: many subsidies actually reduce the cost of overexploiting or polluting the environment, and market prices generally reflect only private costs, ignoring the damages inflicted on others by pollution emissions. Using markets therefore involves moving towards free market prices on the one hand and moving beyond free market prices on the other. As long as markets are reasonably free and competitive, harnessing market forces can be a powerful way to reduce the cost to the economy of achieving environmental goals.

Creating Markets: Market creation is an important way to reduce one of the most persistent and pervasive dangers to sustainable development, the lack of markets for environmental resources and services. Defining property rights, privatizing and decentralizing, establishing tradable permits and rights, and creating international offsets are all examples of the innovations underway in market creation, as highlighted in the policy matrix.

Using Environmental Regulations: Regulations are the most common approach to environmental problems. But they should be used judiciously because of the large direct and indirect costs they impose. Standards, bans, permits and quotas are often favored by policymakers because they promise certainty of outcome - without costly monitoring and enforcement, however, this promise may not be realized. Regulations are in some cases the only feasible instrument by which to achieve the aims of public policy.

Engaging the Public: The final set of environmental policy instruments are those that are a result of public involvement in improved environmental management. It has been commonly observed that governments rarely lead in the fight for an improved environment; more often political leaders respond to public demands for action to address environmental issues. Consequently, information disclosure, community pressure, and public participation are crucial in creating the political will to take effective action.

V. Political Economy of Environmental Degradation

Although some of the policies detailed previously have no financial cost, almost none are politically costless. Industrialists, farmers, loggers and fishermen fiercely – and many cases, successfully – defend their assumed rights to pollute or exploit natural resources. Often society's poorer members, who tend to have the most to gain from an improved environment, play little part in setting the environmental and political agendas. Furthermore, the political economy of environmental damage is heavily influenced by high visibility environmental crises, like oil spills or leaking toxic wastes. Priorities may be distorted away from environmental issues, poor quality drinking water which, while less dramatic in visual terms, puts more lives at risk. Yet another pressure against sound policy is the self-regulation of publicly owned industries, often among the most pollution-intensive sectors of an economy.

To overcome these political impediments to sustainable development, governments need to build constituencies for change and thus alter the political economy of environmental degradation, mostly from the bottom up and with the active assistance of NGOs. To some extent, the political economy of environmental degradation is already changing, as evidenced by the growing public support for environmental concerns. Environmentally educated and aware publics are likely to accept the costs and inconveniences of environmental policies.

VI. Conclusion

Economic Growth or so called “sustainable growth” remains the greatest challenge facing humanity. But despite the unprecedented economic and social progress that has been made over the last generation, environmental degradation persists on a global scale. In other words, environmental considerations have not played any central role in national and international economic theory. To the extent that economic planners have focused on environmental questions, the assumption in recent years has often been that “economic growth and economic liberalization are, in some sense, good for the environment”. Such assertions depend partly on the idea that consumer preferences and the structure of the economy change as a country develops, that development brings more modern and often cleaner technologies, and that growing and richer economies can more easily invest in environmental improvements. Countries in the early stage of development, according to this argument, inevitably focus first on improving their physical infrastructure, basic production, and other forms of material wealth, ignoring pollution and accepting some degradation in the quality of the environment.

The hypothesis is that, in the past, there has been an empirical relationship - in the shape of an inverted “U” curve – between per capita income and some measures of environmental degradation. Such relationships have been investigated for a wide variety of environmental indicators. In effect, such curves suggest that economic growth in a given country will lead to worse environmental degradation until a turning point in per capita income, but then will lead to improved environmental conditions. The upshot of number of such studies is that some environmental indicators do indeed show improvement with increased income, with or without and initial period of deterioration. Other indicators, however, show continued worsening as incomes rises. Most environmental conditions that do improve with economic growth are those that have local impact and abatement costs that are relatively inexpensive in terms of money and changes in lifestyle. However, correlation between economic growth and environmental improvement or degradation must be used cautiously. Any general claim that economic growth leads to environmental improvement must be heavily qualified.

Asian countries containing a large majority of the world’s population will have average incomes below the estimated Kuznets turning points for some time to come. Thus, economic growth in these countries could be expected to increase pollution. Globally, these projected increases would more than cancel out any reduction of pollution in more developed countries.

Positive forces, such as substitution, efficiency gains, innovation and structural changes, can have a powerful effect on the relationship between economic activity and the environment if the

scarcity of natural resources is accurately reflected in decisions about their use. Essential elements of such a strategy (as explained in the policy matrix) will, therefore, include economic policy reform at both micro and macro levels, classification and enforcement of property rights; specifically targeted government policies and regulations to discourage environmentally destructive behaviors and encourage environmental protection or enhancing activities; a greater reliance on efficient, market oriented measures; and a commitment to institutional, participatory capacity building in developing countries. With these elements in place, developing and lesser developed countries will be taking the key steps towards achieving and appropriate balance between environmental protection and economic development.

References

ADB (1997), “Emerging Asia: Changes and Challenges”, Asian Development Bank, Manila.

AET (Asia Environment Technology) (1999), URL at http://www.asianenviro.com.

Asfah, S. (1998), “Impact of Financial Crisis on Industrial Growth and Environmental Performance in Indonesia”, Washington, DC., US-Asia Environmental Partnership.

Barret, S, (1992), Economic Growth and Environmental Preservation, *Journal of Economic Management*, Vol.23(3), pp.289-300.

Barro, R. (1991), Economic Growth in a Cross-section of Countries, *Quarterly Journal of Economics*, Vol.106 (2), pp. 407-43.

Barro, R. and J.W. Lee (1994), “Sources of Economic Growth.” Carnegie-Rochester Conference Series on Public Policy, Vol.40(2), pp.1-46.

Barro, R. and Xavier Sala-I-Martin (1992), Convergence, *Journal of Political Economy*, Vol.100(2), pp.223-51.

Brandon, C. (1994), Reversing pollution trends in Asia, *Finance and Development*, June, 31:2, pp.21-23.

Byrne, M.M. (1997), Is growth a dirty word? Pollution, abatement and endogenous growth, *Journal of Development Economics*, Vol.54, pp.261-284.

Fankhauser S. (1992), “Global Warming Damage Costs: Some Monetary Estimates”, Center for Social and Economic Research on Global Environment, mimeograph (August), London.

Gerschenkron, Alexander (1962), “Economic backwardness in Historical Perspective”. Cambridge, Massachusetts: Harvard University Press.

Grossman, G.M. and E. Helpman (1991), “Innovation and Growth in the Global Economy”. Cambridge, MA: The MIT Press.

Grossman, G.M. and A. Krueger (1993), “Environmental Impacts of a North American Free Trade Agreement”. In: Gabor, P,(Ed.), The US-Mexico Free Trade Agreement, Cambridge, MA: The MIT Press, pp.15-56.

Grossman, G.M. and A. Krueger (1995), Economic Growth and Environment, *Quarterly Journal of Economics*, Vol.110, May, pp.353-77.

John, A. and R. Pecchenino (1994), An Overlapping Generation Models of Growth and the Environment, *Journal of Economics*, Vol.104(427), pp.1393-1410.

Johns, L.E. and R.E. Manuelli (1995), “ positive model of growth and pollution control”. Working Paper No. 52-5, NBER, Cambridge, MA.

Kittiprapas, S. (1999), “Social Impacts of Thai Economic Crisis”, Thailand Development Research Institute, Bangkok.

Knowles, J.C., Pernia, E.M. and Racelis, M. (1999), “Social Consequences of the Financial Crisis in Asia: The Deeper Crisis”. EDRC Briefing Notes, No. 16, Asian Development Bank, Manila.

Lucas, R.E. (1988), On the Mechanics of Economic Development, *Journal of Monetary Economics*, Vol. 22, No.1, July, pp.3-42.

Mankiw, N.G, D. Romer, and D.N. Weil (1992), A Contribution to the Empiric of Economic Growth, *Quarterly Journal of Economics*, Vol.107(2), pp.407-37.

Manne A.S. and Richels R.G. (1990), CO_2 Emission Limits: An Economic Cost Analysis for the USA”, *The Energy Journal,* Vol. 11, No. 2.

Meadows, D. H. et al. (1972), “The Limits to Growth: A Report for the Club of Rome’s Project on the Predicament of Mankind”. Universe Books, New York.

Mohtadi, H. (1996), Environment, Growth and Optimal Policy Design, *Journal of Public Economics*, Vol.63(1), pp.119-40.

Moon, H.P., Lee, H.H., and Yoo, G.J. (1999), “Social Impact of the Financial Crisis in Korea: Economic Framework”. Paper presented at the Finalization Conference on Assessing the Social Impact of the Financial Crisis in Selected Asian Developing Economies, Asian Development Bank, Manila, 17-18 June 1999.

Nordhaus, William D. (1993), Reflections on the Economics of Climate Change, *Journal of Economic Perspectives*, Vol 7, No. 4, Fall, pp. 11-25.

Panayotou, T. (1995), “Environmental Degradation at different stages of Economic Development”. In I. Ahmed and J. Doelman, eds., Beyond Rio: The Environmental Crisis and Sustainable Livelihoods in the Third World. London: Macmillan Press.

Radelet, S., J. Sachs, and J.W. Lee (1996), “Economic Growth in Asia. Background paper for Emerging Asia: Changes and Challenges”, Asian Development Bank, Manila.

Romer, P.M. (1986). Increasing Returns and Long-Run Growth, *Journal of Political Economy*. 99(3), pp.500-21.

Sala-I-Martin, X. (1996), The Classical Approach to Convergence Analysis, *Economic Journal*, Vol.106(437), pp.1019-36.

Sachs, J. and Andrew Warner (1995), “Natural Resource Abundance and Economic Growth”. Discussion Paper No. 517A. Cambridge, MA: Harvard Institute of International Development.

Seldon, T.M. and D. Song (1994), Environmental Quality and Development: Is There a Kuznets Cure for Air Pollution Emissions?, *Journal of Environment and Economic Management*, Vol.27, pp.147-162.

Seldon, T.M. and D. Song (1995), Neoclassical growth, the J curve for abatement and the inverted U curve for Pollution, *Journal of Environment and Economic Management*, Vol.29, pp.162-168.

Shafik, N.T. (1994), “Economic Development and Environmental Quality: An Econometric Analysis”, Oxford Economic Papers No. 46, pp.757-773.

Shrestha, R.M., Bhattacharya, S.C. and Malla, S., 1996. Energy Use and SO_2 Emissions in Asia, *Journal of Environmental Management,* 46, 359-372.

Smil, V. (1996), “Environmental Problems in China: Estimates of Economic Costs”. East West Center Special Reports, No. 5, April, Honolulu.

Solow, R.M. (1956), A Contribution to the Theory of Economic Growth, *Quarterly Journal of Economics,* Vol.70, Feb., pp.65-94.

Titus J. (1992), “The Cost of Climate Change to United States”, in S. K. Majumdar et al., eds., Global Climate Change: Implications, Challenges and Mitigation Measures, Pennsylvania Academy of Science.

William R. Cline (1992), “The Economics of Climate Change”, Institute of International Economics, Washington DC, June.

World Bank (1992), “World Development Report 1992: Development and the Environment”. Washington DC.

World Bank, 1997, “World Development Report 1997”, Washington, D.C.

World Resource Institute (WRI), 1998, “World Resources: 1998-99”, Oxford University Press, Washington, D.C.