

Developing Economies and the Environment: The Role of Trade and Capital Flows*

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This paper reviews (critically and selectively) the literature on the link between economic development, the environment and international trade (and capital flows). In particular, how stricter environmental regulation in the North affects trade and capital movements between the North and the South. It also discusses how trade and capital flows in turn, affect environmental policy.

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1. Introduction

About half a century has elapsed since the process of decolonization gathered steam. Since then the newly independent developing countries have been looking for ways that would enable them to close the yawning gap in their standard of living with those of the developed countries. At that time, economists (nearly unanimously) felt that these countries needed to save more and accumulate capital to close this gap. There were those who believed that industrialization should be an inward-looking process, while others favoured integration with the world economy. In the early stages of the debate, with an emphasis on growth models, environmental issues were totally disregarded — indeed as late as 1991 a very influential survey on development economics and public policy is resoundingly silent on the topic of environmental degradation.¹ Only in the last decade or so there is a grudging acknowledgement that environmental considerations need to be

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¹ See Stern (1991a). Also see the companion piece on economic growth (Stern (1991b)) where, again, there is no discussion of the environment.

addressed when discussing growth issues.

Where such environmental considerations are entertained, output is assumed to be produced using the available technology and factors like labour, reproducible factors (like capital) and natural resources. Production thus uses renewable and non-renewable natural resources. The former e.g., flora and fauna, grow through natural reproduction. The latter e.g., fossil fuels and metal deposits, do not. Production and/or consumption uses up natural resources, while at the same time changing the characteristics of other life-sustaining elements like air, water etc. The environmental input consists of the damage to these through pollution and the degradation of the renewable resource stock, e.g., land, the habitat of wild-life etc. As should be obvious from this outline, an analysis of these issues would involve many disciplines beside economics, e.g., ecology, geology etc.

Economists do occasionally stray into the territory of these other disciplines (and not always to conduct multi-disciplinary analysis!). This happened following the first big oil price shock in the mid-1970s when there was an animated discussion on the substitution possibilities between natural resources (especially exhaustible resources) and other inputs and whether the growth process itself was without limit. A major strand in this debate revolved around the question as to whether changes in technology can substitute for natural resource inputs especially non-renewable ones². While we do not know what the future holds, in the recent past it is actually the case that energy use has grown much slower than output growth — e.g., between 1960 and 2000, energy use in the US, the EU and Japan grew at annual rates of 1.4, 0.4 and 0.2 respectively.³

The notion of “sustainable development” or “intergenerational equity” tries to come to grips with the dilemma posed as to how to raise current living standards while, at the same time, ensuring that the environmental consequences are “not too” damaging i.e., it should not affect adversely the availability of the natural capital that is left for the future generations.⁴ For this we need make operational the concept of a stock of environmental or natural capital, since we are interested in tracking the path of such a variable over time. Any precise operational definition of the concept of sustainability has proved elusive. The reasons are not far to seek — we need preferences to be defined over a very long (possibly infinite) horizon, a catalogue of possible new products and how technical progress, population size, etc will evolve over time. The issue of sustainability has popped up even in the context of the (mainly theoretical) endogenous growth literature with

² See, e.g., “The Symposium on the Economics of Exhaustible Resources” in the *Review of Economic Studies* 1974, Vol 41 pp. 1-152.

³ See Smulders (2006) for a discussion of these issues.

⁴ See John and Pecchenino (1994) for an infinite horizon economy with environment quality but agents with shorter life spans. See also Uzawa (2001) for an attempt that is very restrictive, possibly misleading.

some seeing growth ultimately petering out as environmental degradation continues (e.g., Stokey (1998)) and others who see uninterrupted growth (e.g., Hartman and O-S Kwon (2005)) — the latter, of course, have to assume that pollution ultimately is reduced below the level that the earth's absorptive capacity can handle. Whatever the theoretical and empirical imponderables, one still hopes that there are flows (i.e., production and consumption of goods), which we can identify as helping or hindering the cause of sustainability. The development process of the currently rich countries — the North — was very “dirty” i.e., destructive of the world's environment. A duplication by the South of that path of industrialization is clearly not feasible — a view that is widely, but not universally, held.

This paper is concerned with the issues of development and trade and capital movements between the North and the South. In particular, how these interactions are affected by the environmental regulations in the North and how the trade and capital flows (or the threat of these) affect environmental policy. I will outline these issues in a neoclassical framework and my discussion of general issues relating to environment and international trade will be brief, since these are discussed elsewhere e.g., van Beers (2006). But before I turn to the North-South interactions, I want, by way of preliminary, to discuss one question that has played a prominent role in the growth, trade and environment debate: How does economic development affect the environment?

The relation between economic development and the environment is a complex one. As mentioned above, the richer countries (the North) have industrialized in a very dirty manner primarily because the environmental consequences of growth were not an issue at that time. Over time, their production techniques have become cleaner. A concept that has received a lot of attention recently is the so-called Environmental Kuznets Curve (EKC).⁵ This tries to relate the emission of various pollutants to the GNP per capita of a country. It started off as a cross-section exercise but its predictions also have time series implications.

The EKC is the empirical observation that a lot of pollutants have turning points with respect to income levels per capita. Examples of these are sulphur dioxide, oxides of nitrogen, water pollutants, suspended particulate matter (SPM) etc. Grossman and Kruger(1995) find SPM and SO₂ have a turning point at \$ 5000 per capita (1985 US \$), while Selden and Song (1994) note aggregate pollution of these come down at a much later stage of development. On the other hand, carbon emissions and solid waste do not have any turning points at all.⁶ As will be discussed

⁵ See Grossman and Krueger (1995) for the original contribution, Andreoni and Levinson (2001) for a theoretical model and Dasgupta et al. (2002) for a survey.

⁶ For instance, per capita consumption of polythene rose from 2 kilograms annually to 4.5 kilograms between 1980 and 2005 and shows no signs of tapering off,

below, the latter class of pollutants can pose serious challenges to the development process of the South, and possibly of the world as a whole, because it is the accumulated stock of these pollutants (as opposed to the flow in any time period) that causes concern. Without going too much into the details of the process at work, one may hazard a guess that as society becomes richer some types of pollution may be easily tackled (and policies to tackle these are put into place because firms and individuals in isolation have the incentive to correct these “externalities”). But for other pollutants the cost of clean-up may be very high (as for carbon emissions). One issue that is not addressed by the EKC⁷ is the time frame taken to achieve the increase in GNP per capita. For instance Japan grew at an average annual rate of 8.07 between 1955 and 1973. This implies that because Japan was a latecomer to the development process it had access to cleaner technologies (compared to the early industrializers like the UK) but it was also compressing into two decades what the UK might have taken a hundred years to achieve.

2. An Overview of North-South Economic Interactions

As should be evident from the discussion the introduction, even in the short run the word “environment” is too all-encompassing, especially in the context of the North–South divide. The South’s major concern under the heading of environment is a requirement for population control, access to clean water, land which is not degraded, etc. Northern concerns are primarily with pollution — how the South’s production activity affects the pollution content of their exports – and the level of harmful atmospheric gases and the effects on sinks for those gases, such as tropical forests. The interface between international trade theory and environmental economics also focuses its attention primarily on these issues.

Any discussion of North-South trade in an environmental context presumes that the South is better endowed with the environmental “input”. It is also undoubtedly true that much of the world’s bio-diversity is located in the South, as is the stock of mineral deposits. But it is not true in all cases — the number of kilograms of effluents per US dollar of output vary enormously across countries and there are effluents e.g., for which Indonesian production is cleaner than the US. When disaggregated by sectors the picture becomes even more hazy. For example, for air toxicity US textile production is much dirtier than that of Mexico — -this is true even for plastics.

Let us, however, follow the standard presumption and assume that the South is better endowed in “the” environmental input. It should therefore export goods that use the environment intensively. While the empirical evidence in favour of this is far from clear-cut, concerns have been raised

⁷ It was, as mentioned above, initially a cross-sectional exercise.

(mainly in the North) that the South is deliberately exploiting its environmental resources to gain an unfair advantage in trade. There are also fears that the South's actions are not "sustainable".

Northern (labour and environmental) lobbies fear that as environmental standards are raised in the North, mobile factors of production will move to the South where the environmental standards are lax, and they want similar environmental standards to be adopted in the South. The evidence on foreign investment by multinationals does not support this hypothesis of lax environmental standards as a major determinant of these flows. The South views this, quite justifiably, as unwarranted protectionism — a form of non-tariff barriers.

In matters of trade and capital flows, the North has the commanding heights of the world economy. A rough estimate indicates that the top 20 per cent of the world's population gets about 80 per cent of the world GDP. Most relative prices in the international economy are determined in the North because of its share in total world wealth and its organized markets (there are exceptions though — oil prices being a good example of this). The South takes world prices and the North's environmental policy stance as given. This implies that the South has to share the environmental agenda of the North.

Broadly speaking, the post-war free trade system ushered in by GATT has benefited the South. Poor countries have used trade as an "engine" of growth. This is however not true for all the developing countries. For instance, contrary to intuition, in cross-country regressions on growth, natural resource endowments usually show up with a negative coefficient. Some of the natural resource rich economies have faced a secular terms of trade deterioration. Leaving these countries aside, over time, as parts of the South have industrialized, the developed countries have introduced other items in the GATT / WTO agenda — e.g., trade in services, intellectual property rights etc. This signifies a move, implicitly, to cede manufacturing to the South. The South has misgivings about some of these new items but it is true that these are new issues that were not around when the original GATT agenda was formulated. In the Northern protectionist lobbies in the past low wages in the South was seen to be the main cause of the loss of industrial jobs in the North. Now with successive tightening of environmental standards in the North, low environmental standards in the South are also seen as causes for unemployment in the North — presumably even allowing for the increased activity due to cleaning up still involves a decline in employment in the North. Hence the call for "fair" (as opposed to "free") trade and objections to the South's (low) environmental (and labour) standards.

The South has also benefited from FDI as the new machines create employment while embodying the latest technology. Historically, since colonial times FDI has been undertaken by the North in the South. But in earlier periods, these went into mining and other extractive sectors

and hence were not a cause for concern among the organized labour in the North. But since decolonization, and especially since the rise of the newly industrialized countries in Asia, manufacturing activity has started to move in a big way to the South. There is a fear that environmental concerns in the North will raise costs of production there causing a shift in comparative advantage to the South where standards are more lax. And for certain activities it would be profitable to shut shop in the North and relocate to the South — the “pollution haven”. In addition, if FDI moves to locations with lower environmental standards, there could be a competitive lowering of standards in the countries of the South. If the North lowers its environmental standards in response to this, we have the so-called “race to the bottom”. Thus in this view trade exports jobs and investment abroad only makes this more irreversible. There are those who are opposed to this view and point out that multinational corporations provide the latest technology and work practices in their plants located in the South. The evidence, reviewed briefly in the next section, on this issue suggests that in the past multinationals’ environmental standards in the plants in the South were considerably lower than in the North. It is possible that in more recent times there is a tightening of standards as environmental practices of multinationals are subject to greater scrutiny in the North.

For about two centuries economists have used the concept of comparative advantage to explain the pattern of production and trade in the world. In a simplified two-country two-commodity framework this simply boils down to asking: which is the commodity that the country produces at lowest cost (in relative terms). This, however, does not guarantee that the good will be exported. For this we require not only that preferences be identical but also homothetic (i.e., when faced with the same (relative) prices, all individuals consume all the goods in the same proportion — this rules out the case where the wealthy are more environment-conscious). Without identical homothetic preferences, tastes, by themselves, could constitute the explanation of trade.⁸ As is well-known, there are two major theories of international trade viz. the Ricardian theory and the Heckscher-Ohlin theory. The former emphasizes differences in technologies to explain comparative advantage while the latter relies on relative factor abundance. In the last thirty years a third explanation — the “new” theory — has emerged. It relies on market structure and increasing returns to explain the pattern of trade.

We saw above that in the environmental economics literature, “the” environment is treated as a factor of production. This begs the question of how do we construct an aggregate for the environment. It is a shortcut for a more long-winded statement viz. that production pollutes, and

⁸ In equilibrium, of course, we just need that preferences are not strong enough to offset the production advantage. Thus identical homothetic tastes seem overly restrictive. But starting of from a decentralized set-up (i.e., where households and firms plan separately), identical homothetic preferences will always ensure that preferences do not constitute the cause of trade. I am grateful to the referee for seeking a clarification on this point.

hence pollution is an output jointly produced with the final good and a reduction of pollution (for a given level of output) – abatement – is costly. But what is the “true” price of this input? It is whatever the society thinks it is worth. But that, in turn, depends on preferences. For instance, a society, which values the environment more, would be willing to sacrifice more of other goods for this. Clearly taste differences are very important here. Also, presumably the pollution input is variable, so its endowment is endogenous and changes over time — see the discussion on sustainability in the Introduction.

Thus, poorer countries may tend to put a lower value on a clean environment and hence are considered to have a large endowment of pollution intensive goods. For example, Japan has a very large forest cover but imports logs from South East Asia. Similarly a poor country would probably deplete (even exhaust) its natural resource base at a rate higher than if it were richer. It is this kind reasoning that led the then Vice President of the World Bank, Larry Summers to suggest that industrial waste should be shipped from the North to the South — the South does not have a technological or ecological superiority when it comes to absorbing waste but today is poorer relative to the North.

3. Policy Issues in North-South Trade and Investment

3.1. Preferences, Environment and Trade Policy

Four (possibly five) channels that link international trade and the environment are identified in the literature — two of them familiar from the standard trade theories. First, in line with the international trade theory, depending on a country’s comparative advantage there is a composition effect — who will produce what and how much? In a closed economy all the demand has to be met by domestic production — trade allows a country to specialize. Second, trade may impose restrictions on the technique of production — in the simple Heckscher-Ohlin model with trade and incomplete specialization in production, the techniques are identical across countries. Third, international trade raises world incomes, which, in turn, changes the scale of production. What are the consequences of this change in scale on the environment? Especially if environmental taxes were not at their “Pigovian” level (i.e., equating the tax with the marginal damage pollution causes to society) to start off with. And finally, as trade raises incomes, people have a higher willingness to pay for a clean environment. A possible fifth channel is something not present in competitive models — as trade raises incomes, a larger market enables cleaner and more expensive technologies (with higher fixed costs) to be introduced.⁹

⁹ In Ghosh and Sen (2006) this idea is pursued and they show that in the short run, following a liberalization of trade with given technologies, pollution rises. As incomes rise better technology can be put installed — this accords well with the historical experience of Japan and Korea.

In a series of papers, Copeland and Taylor [(1994), (1995)] have analyzed the interaction between trade and the environment assuming that governments always set taxes at the Pigovian levels.¹⁰ These papers look at differences in pollution standards with policy evolving endogenously with incomes. Countries are assumed to have identical factor endowments. In the first of these papers they look at a model of the world economy where pollution is local and the North sets a higher environmental standard. This has a composition effect, causing the polluting industry to contract in the North and expand in the South. As incomes rise in the South, the willingness to pay for a cleaner environment also rises — this means income effects, discussed in the previous section, are important — but the usually the composition effect dominates and the South ends up with a higher level of pollution, while in the North pollution declines.

In Copeland and Taylor (1995), on the other hand, all pollution is global, and increased trade relocates production from the North to the South, leaving world pollution unaffected — the South gains and the North loses from free trade due to the existence of a “pollution haven”. Moreover if a free trade agreement were to freeze pollution at the autarky levels, then the North gains and the South loses. This possibly explains why the North (or lobbies within it) wants to link the environment to trade and the South opposes such a move.

Given that trade policy has effects on the scale, technique and composition of output, a question that arises is whether trade policy (via a tariff or a quantitative restriction) should be used to correct an environmental distortion? The answer from international trade theory is, in general, “no”. If the environmental distortion is the only departure from a competitive structure, then the best policy (called the “first-best policy”) is to tackle the pollution at its source — through a Pigovian tax.¹¹ Trade policy can at best be a second-best solution. This is not an arcane theoretical issue in the North-South context. By granting other nations the “Most-Favoured-Nation” status under GATT-WTO, the North has surrendered its market power. It could levy the equivalent of an optimal tariff by imposing environmental taxes, which raise tax revenue and deteriorate the South’s terms of trade. The North could get a “double dividend” if the terms of trade advantage and the tax revenue by lowering other distortionary taxes more than makes up for the direct contractionary effect of the environmental taxes — see Sen and Smulders (2000) for a model of this phenomenon.

One form of North-South interaction that is becoming very important and requires a different set of analytical tools is the protection of the so-called “global commons” — see Finus (2006) for a

¹⁰ See also Antweiler et al. (2001).

¹¹ This is true in very simple models. A departure from the Pigovian level is called for when, for instance, there is double moral hazard (see Aggarwal and Lichtenberg (2005) or there is a cost of verifying the state (see Cremer and Gavahri (2002).

summary of the arguments.¹² If the global commons is viewed as a public good, then free trade is no longer optimal and trade policy may not be the optimal response to the problem. Matters are further complicated by the fact that the environmental effect on these commons can take a very long time to manifest themselves. For instance, overfishing in oceans may cause the disappearance of the fish stock only gradually over time. The disappearance of the ozone layer due to the build up of greenhouse gases (GHGs) and CFCs is a better-known example. The scientific evidence on the greenhouse gases and their effect on global-warming is not precise but it suggests that though the problem currently is not serious, it will become so if the carbon emissions continue unchecked. Thus the flow of carbon emissions into the atmosphere accumulates, subject to some absorptive capacity of the atmosphere, and it is the stock of the greenhouse gases that deplete the ozone layer. As with overfishing, these processes are subject to irreversibilities — mankind cannot make the ozone hole, once made, disappear through responsible behaviour. But at present, action can be taken to prevent the hole from getting larger.

Our discussion above of the EKC assumed that various emissions had turning points because richer countries cared more about the environment — of course, for various pollutants these turning points are different. This is no longer true if the receptacle of emissions is the earth's atmosphere. Here no individual nation has an incentive to spend on cleaning up — a classic case of free riding and under-subscription of the public good.

Three facts about carbon emissions should be kept in mind. First, emissions per capita in developed countries are about 25 times as high as in developing countries. Second, the US, China and Russia account for over 50 per cent of the world's emissions. Third, carbon emissions per \$ of GNP produced is much higher in developing countries than in the developed countries — this implies that their energy conversion is inefficient.

On the empirical side, Whalley (1991) reports some CGE based results on inter-country effects of a carbon tax in a three-bloc (static) model — the blocs being oil exporters, oil-importing developed and developing countries. Three kinds of policies are examined — a national production-based tax, a national consumption-based tax and a global tax with revenues being rebated on a per capita basis. As would be expected, developed countries lose less from a consumption-based tax (since they get to keep the revenue) than from a global tax. For the developing countries the ranking is opposite of this — in fact, they actually gain from a global tax. The oil-exporters prefer the production tax, since they get to keep the revenue. Thus both the incidence of taxes and the distribution of tradable permits are important here.

¹² See the discussion of Copeland and Taylor (1995) above.

There are two aspects of international environmental agreements (IEAs) of interest to us. First, these treaties usually involve carrots (in the form of transfers for members who might lose from participating in the treaty)¹³ and sticks (providing some punishments for non-compliance). It is interesting to note, en passant, that there are some purely voluntary IEAs also. For instance, the Sofia Protocol of 1988 on controlling emissions of nitrogen oxide has been successful in reducing emissions of these gases by 2.1 per cent in the period up to 1996 (see Bratberg et al. (2005)) — a fact that is important since most analysts believe that IEA targets usually are very generous and resemble (non-cooperative) Nash outputs.¹⁴

The second aspect of these agreements worth commenting on is regarding the modelling strategy adopted. Each country is assumed to be a closed economy but for the transboundary consequences of the emissions of greenhouse gases.¹⁵ This misses an important channel alluded to above viz. terms of trade changes. For instance, Carraro et al. (2005) allow different potential signatories in the IEA to differ in terms of marginal damage and marginal costs of abatement — this actually leads, in their analysis to some players being more crucial to coalition-building to reduce GHGs than others. But primary goods producers are “upstream” agents and if the demand for their product from abroad falls, they suffer a terms of trade loss.

On this issue, a recent paper by Copland and Taylor (2005) set the cat among the pigeons by showing that in a trading, as opposed to a closed economy, framework some conventional results get overturned. For instance trade in emission permits may not be necessary for equalization of marginal abatement costs.

3.2. Property Rights and Trade

A different literature identifies North-South trade in terms of different institutions of property rights. As an economy gets integrated into a market system, traditional collective (community) ownership of “the commons” breaks down. Migration takes place and a sense of community disappears. Property rights previously vested in the community become ill-defined. Examples of this abound — forestry, rivers, oceans etc. Free riding becomes possible in this scenario — one may extract from the commons without penalty or deterrence. Much has been written on the question of overharvesting by the trawlers of fish stocks on the Atlantic Coast off Canada and also the conflict it often gives rise to between traditional fishermen, as in the case of the trawlers

¹³ See Carraro et al. (2005) for a discussion of the role of transfers and its neglect in the theoretical literature.

¹⁴ See Murdoch and Sandler (1997) for such a view on the Montreal Protocol of 1987 that had been otherwise thought of as a successful IEA.

¹⁵ See Nordhaus (1993) for a summary of such an approach.

from EC countries off the coast of Senegal.

In the South, apart from a breakdown of traditional forms of communal ownership, there is a problem of widespread corruption and weak law enforcement. In this situation, state-owned land is often treated as a common access regime — forests, game parks (sometimes even government-owned financial institutions function like an open access regime!) etc. are examples of these. In such a situation it is not clear that the traditional cure for market failure — government intervention — improves things. We have to trade off government (or policy) failure against market failure.

The first paper to highlight the effects of property rights on trade was Chichilinsky (1994). She started off by assuming that in a North-South trade model there is no difference between these blocs in terms of endowments. The difference lies in the property rights — the North has well-defined property rights and the South has an open access regime. An open access regime leads to an over-harvesting of the environmental resource in response to current prices. Additionally, since appropriation of returns is a problem, there is no incentive to manage the resource in an optimal way from a dynamic viewpoint — this leads to disappearance of fish stocks, forests etc.

Given an open access regime in the South the environmental resource is over-harvested and the South shows an “apparent” abundance of the environmental resource. If tastes are identical and homothetic, in autarky the price of the environmental good will be lower in the South. Free trade will cause the North to import the environment-intensive good from the South, thus exacerbating the overexploitation of resources. These give rise to “apparent gains from trade.” Trade is actually welfare-reducing (a competitive equilibrium does not represent the scarcity values to society) but without looking at the cause of factor abundance, it does not appear to be so. Similarly, one can see that if the natural resource were exhaustible, it would be exhausted faster than would be the case if the property rights were well-defined. In Brander and Taylor (1997) and (1998), it is shown that in such a set-up, a tariff can improve welfare — it corrects the absence of property rights.¹⁶

There is evidence in favour of this. Consider the imports of logs by Japan. Japan, after an initial burst of depletion of its own natural resources, has been very protective of its own forest cover and has imported logs from Indonesia and Malaysia. In these countries — where property rights are not always well-defined — there has been widespread depletion of tropical forests, with concerns elsewhere in the world about the disappearance of “the global commons”. While

¹⁶ Smulders et al. (2004) caution us about trade restrictions being necessarily good for bio-diversity in the Brander and Taylor set-up. Trade restrictions could lead to an expansion of agriculture which, over time, leads to a destruction of habitats.

logging may be a labour-intensive activity, stricter regulation in Japan and the property rights regime in the exporting country are also important in depleting the forest cover.

3.3. Models of Capital Flows

There are few theoretical (and empirical) studies that address the issue of FDI. Traditional FDI models were about locational advantage which had to be availed of in a particular place. One example of this was the tariff-jumping theory of FDI — the host country had a market that could be provided for cheaply by locating production there, otherwise a tariff had to be paid. Recent FDI models have talked about horizontal FDI — i.e., the production of some brands a product move to the South. There is a counterpart in the environmental literature, when production is not so much attracted to the South by its regulations but is repelled from the North through the tight environmental regulations there. As an example consider the following: Both the North and the South have some capital and some polluting inputs and produce a homogeneous good. Both inputs are footloose in that they respond to price changes but only capital moves internationally. If capital movement is allowed, capital moves from the capital-rich North to the environment-rich South. This brings the environment-capital ratios together. In an integrated world — i.e., when capital yields the same rate of return everywhere — a tightening of environmental standards causes capital to flow out and FDI may actually increase pollution in the recipient country.

A more recent type of model for FDI concerns vertical FDI where some parts of a production process is fragmented and moved to the South because of its lower labour costs. There is no reason why these costs cannot be environmental costs (see Markusen et al. (2001)).

A different kind of capital movement that has become important in the last few years is that of financial capital. For instance, the East and South-East Asian and Latin American economies have opened their capital accounts to financial flows, though in the wake of the Asian crisis capital flows to these countries had dropped significantly. What is the relationship between the ability to borrow in the international capital markets and the environment? Consider the following example: Citing the poor human rights record of the Indonesian government, there have been calls for all capital flows to be cut off to that country. What would be the effects of these on the environment? If Indonesia viewed the Asian crisis as a temporary setback, it would try to borrow and smooth consumption. If all lending is cut off, then it may seek to find other ways to prevent a sharp drop in its consumption. It may choose to cut down parts of its remaining forests that the rest of the world believes plays a role in acting as a sink for GHGs. Higher consumption could be polluting but may be better in terms of protecting these sinks. This simple example shows how access to international capital market may allow poor countries to

borrow against higher future income and relieve some pressure on the (global) environment.

4. Some Empirical Evidence

In this section I shall review some of the empirical evidence. I shall endeavour to cover the evidence on: (a) Heckscher-Ohlin type models — most of the empirical literature focuses on this, (b) on foreign investments and the pollution-haven hypothesis, and (c) environmental consequences of agricultural exports.

4.1. Empirical Evidence on Environmental Costs and Trade

Do higher environment standards raise costs of production within an economy? There are studies that find environmental costs do impact on industrial production patterns e.g., these costs show up in new investment of the chemical industry across USA. Do these effects of environmental standards on costs show up in the pattern of international trade?

The results are mixed. Studies such as Lee and Roland-Holst (2001) report in a study involving trade between Indonesia and Japan, an “increase in relative output share of dirty industries causing higher pollution intensities for almost all major product categories” following liberalization of trade. Over time however, Indonesia's pollution intensity in the traded goods does come down.¹⁷ Antweiler et al (2001), on the other hand, find evidence for sulphur dioxide emissions going down after trade liberalization.¹⁸ It would be fair to say that the effect of environmental costs on trade patterns is not strong. The poorer countries have had a higher growth rate of dirty industries in the 1970's and 1980's subsequent to the tightening of environment standards in the North. Indeed the share of dirty industries has increased for a few developing countries and for the developed countries it has declined. This evidence is not direct proof of the existence of any “pollution havens”, because during this period the developing countries grew (in terms of GDP) significantly faster than the developed countries. It is still the case that most of the dirty goods production is still in the North!

Why is the effect of environmental costs not more pronounced in the international trade data? Three reasons have been suggested for this apparent anomaly. First, trade accounts for a relatively small share of world production. Second, a large share of trade involves trade in environmentally clean goods. And finally, even for dirty goods, abatement costs account for a relatively modest share of total costs.

¹⁷ This is consistent with the theoretical model of Ghosh and Sen (2006).

¹⁸ It is a pollutant that is relatively easy to abate through the use of scrubbers. Its disutility is also very clear—it irritates the eyes. Hence it is a pollutant whose removal is a priority as incomes rise.

What is true of data on international trade is also true of macroeconomic (i.e., computable general equilibrium) models. For instance, the effect on welfare of fairly large decreases in carbon emissions are modest — emissions cuts rising to 40 per cent by 2050 never exceed 1.5 per cent of GDP except for Japan. This cutback is expected to have a substantial ‘leakage’ (i.e. increases elsewhere) effects – as high as 70 per cent. This is caused by a decline in world demand for energy, which makes non-EC economies use more of it. It is possible that the small welfare effects are due to the models being competitive, full employment models. If, on the other hand, there was strategic interaction between firms, there could be relocation of plants after a threshold, and hence the effects of emission regulation and how these are achieved could be substantial.¹⁹

A different way of looking at the relationship between trade and the environment is to look at the experience of economies which have relied on a trade-led growth, e.g., Japan and the East Asian economies. Looking at Korea one finds during the 1960’s, and even as late as the early 1990’s, environmental policies were almost absent. This led to an industrial structure which was very intensive in energy and materials, although Korea had very little of either. The export share in output in the mid-1980’s was about 30 per cent but it generated 30 to 50 per cent of waste (pollutants, solid waste etc.). Japan similarly had a very poor environmental record in the early post-war years but in recent times Japan has reduced its environment-intensive exports significantly — except for steel. Similarly it is expected that the effect of Chinese growth will cause a rise in total pollution as China moves its employment from agriculture to light industry — this is the third channel mentioned at the beginning of the previous section. The pollution intensity of agriculture, which will become less labour-intensive as labour is sucked out of agriculture, will also rise.

Finally, it is important to remember that there are products whose production is banned in the North, but continue to be manufactured and/or sold in the South — the South is completely specialized in the production of these. Asbestos is a product that continues to be sold in the South without adequate warning. In early 2006 a French warship, *Clemenceau*, was sent to an Indian port for stripping but was sent back after a furore over the unknown quantity of asbestos it was carrying. DDT, a pesticide, is another health hazard whose production in the South has not ceased.

4.2. Evidence on FDI

The evidence on the environmental consequences of FDI is sketchy (as was the theory). Most of

¹⁹ Markusen et al. (2001) find that under a non-competitive set up these costs can be substantial.

the empirical work deals with relocation within the North.

Overall, for most commodities in recent times, it would be fair to say that low environmental costs are also not a major cause in deciding on location — e.g., Javorcik and Wei (2004) have done a thorough study of investment decisions in the former Soviet Union and the Eastern European countries and decisively reject the pollution haven hypothesis. Law and order would probably be as important. Also if the good was meant for export then the environmental consciousness in the export market is also a consideration — indeed this has brought to the fore the issue of the North “dictating” the production *processes* in the South. But there are industries for which the environmental regulation could be a major factor. It has been found that between 1973 and 1985 overall FDI by the US chemical and mineral industry increased at a rate faster than overall FDI by the US. Sulphur emissions allowed in the host country, is seen to be an important locational choice variable for the US chemical industry.

Researchers have found a favourable effect of trade and FDI taken together on the environment. Among the countries of the South, countries with an outward-orientation have cleaner technology than inward-looking import-substituting ones. Market pressure causes rapid obsolescence and import of capital goods leads to the acquisition of the latest technology. This is broadly consistent with the discussion above where a country in the South that is open to foreign capital flows is forced to move its techniques in tandem with what is happening in the North. The post-war historical experience of Japan, with its dependence on trade and a very fast rate of technical progress also bears this out.

Turning to the historical experience, FDI in Korea was pollution-intensive in the early stages of industrialization. This included heavy investments in petrochemicals, chemicals and metallurgy. It is only later that less polluting electronics etc. were added to the list.

One of the biggest environmental disasters involved the US multinational Union Carbide. In 1984, a gas (methylisocyanate) leak, in its plant in Bhopal, India, killed between 2000 and 5000 people and over 80,000 people had their lungs permanently damaged. The Union Carbide plant in Bhopal had lower standards than its plant in West Virginia USA, where such an accident was unlikely to occur.

Another example of lax standards was Mitsubishi’s chemical plants in Malaysia. These used to dispose of radioactive thorium waste in plastic bags — this was admitted only under legal pressure.

4.3. Agricultural Exports and the Environment

Turning to agriculture, we can divide the transformation in agriculture due to a change in practices as (a) changes in eco-systems i.e., loss of bio-diversity, (b) changes in natural endowments e.g., pollution, soil deterioration, and (c) loss of sustainability. Damage could be on-site e.g., land erosion, damage to farmers from pesticides, or it could be off-site e.g., water contamination, acid deposition from ammonia emissions.

Three examples of changes in agricultural practices in the South in response to a rise in export demand are given here. Export demand for cassava grew for intensive pig farming in the Netherlands. This was because root crops had their tariffs lowered in the GATT rounds in the 1960s (as opposed to cereals). Thailand and Indonesia responded to the increased demand for cassava. The fragile upland soils of Java and forest lands in the Outer Islands came under monocropping of cassava — similarly in Thailand forest land in north-east Thailand declined by about 50 per cent. When the export boom ended, the land growing cassava was found to be extremely degraded.

Similarly the demand for grain production especially soya bean caused a conversion of large areas of the Argentine pampas with increased use of chemical fertilizer and a scrapping of the traditional crop rotating practice. Soil erosion in the new crop areas were often 65 per cent more than with the traditional crop rotating practice.

Shrimp cultivation in Ecuador (and Honduras) for export to the US and Japan resulted in transforming the mangrove areas into pools for shrimp farming. This resulted in high shrimp yields initially but then yields have fallen sharply due to the destruction of the mangroves.

Finally, some authors have argued that a liberalization of world agricultural trade — the Northern agriculture receives subsidies and protection — would make Southern incomes rise and the world would move away from environmentally unfriendly (chemical fertilizers and sprays) to labour-intensive sustainable methods. One must approach these conjectures with caution because we are talking of non-marginal changes here. Producer subsidy equivalent (PSE) in 1993 was 42 per cent of the value of OECD agricultural output. It would involve major changes in employment patterns, demand for fuel etc. all over the world. Similarly, as the three examples above show, an increase in Southern agricultural output is not necessarily good for the environment.²⁰

²⁰ See Smulders et al. (2004) for a model where agricultural expansion is bad for bio-diversity.

5. Conclusions

In this paper we first reviewed the literature on environmental degradation and growth. Then we looked at environmental linkages between the North and the South — these links have come to occupy the centre-stage in international negotiations on trade liberalization. Notions of comparative advantage seem to suggest that the availability of environmental inputs should have implications for location of production and/or trade. Since the South has environmental regulations that are relatively lax, it has a comparative advantage in environment-intensive goods. A tightening of environmental regulation in the North would reinforce this.

The data, if at all, lend only very limited support to this hypothesis. This is possibly due to the fact that the environmental costs are a very small proportion of total costs. Other considerations, including environmental consciousness in the export market, are possibly more important. Similarly, in the decision to invest abroad, environment considerations though they may be present are not paramount.

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