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TOPIC PAPER

THE IMPACT OF ENVIRONMENTAL POLICY IN DEVELOPED COUNTRIES ON THE TRADE OF DEVELOPING COUNTRIES IN THE ESCAP REGION

by

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ABSTRACT

This paper focuses particularly on the trade effects of environmental controls as applied to production with emphasis on production and processing of raw materials.

Theoretical models suggest that in general, the diversion of resources from material goods to environmental goods in developed countries will have adverse effects on trade between developing and developed countries.. Empirical analysis from three developed countries, however, indicates that expenditure on environmental protection probably has little impact on such trade but could be beneficial insofar as such expenditure can be stimulatory in its effect on developed economies.

The imposition of product standards by developed countries has adverse effects particularly on developing countries highly dependent on agricultural/foodstuffs exports and on manufactured imports. These countries tend to face difficulties in meeting developed country product standards for their exports, and to suffer from inappropriate product standards imposed on their imports.

Pollution controls result in changes in relative prices; an examination of the effects on 11 ESCAP countries of the United States and Japanese estimates of price effects of pollution indicates that the large majority suffer a deterioration in terms of trade, with only Singapore showing a clear improvement. Pollution control costs are relatively high for raw materials processing activities, but there is no strong evidence to indicate that this factor on its own contributes in more than a limited manner to the relocation of processing activities in developing countries of the region. Therefore any welfare gain from this factor compensates little for the welfare losses from terms of trade deterioration.

In sum, the general influence of environmental controls on patterns of trade and investment is weak beside the major shifts in comparative advantage occurring in the region which are the result of other factors.

I. INTRODUCTION

In recent years interest in environmental issues has extended to consideration of the effects of environmental controls on international trade and payments.[1/] Since the bulk of developed country trade is with other developed countries, whose environmental problems are likely to be broadly similar, simultaneous implementation of environmental protection policy by developed countries might not be expected to have substantial over-all effects on the trade and payments of those countries individually.[2/] Of rather greater interest is the possibility that the adoption of relatively stringent environmental controls in the developed world may influence the pattern and/or volume of trade between developed and developing countries, to an extent which has significant effects on the pace and nature of economic development in the latter group of countries.

This study examines the analytical issues involved in assessing the impact of developed country environmental policy on developing country trade, reviews some of the general empirical evidence which has been assembled, and attempts to assess the likely nature and magnitude of some effects on the trade of developing countries in the ESCAP region. The remaining part of this section presents a brief introduction to the main issues in the debate.

As implied above, the basis of much of the discussion is the proposition that the level of environmental controls in the developing world is, and will continue for some time to be, significantly less stringent in general than that adopted by developed countries. Relatively high pollution controls costs for production processes in developed countries might be expected to increase the competitiveness of developing country production in international markets for some commodities.[3/] Less directly, differential pollution control costs in production may lead to substitution by producers between raw materials or to substitution by consumers between final products, and these substitution effects may either increase or decrease demand for developing country exports of raw materials.

/Trade

1/ See, for example, Ingo Walter (ed), Studies in International Environmental Economics (New York, Wiley, 1976) and "Industrial pollution control and international trade", GATT Studies in International Trade (Geneva, 1971).

2/ This view seems to be borne out broadly by estimates of the impact of introducing environmental controls in five developed countries - R.C. d'Arge and A.V. Kneese, "Environmental quality and international trade", International Labour Organisation, 1972.

3/ Throughout this paper, the term "pollution" is used to mean environmental damage of any description, aesthetic or physical.

Trade between developed and developing countries may also be affected by controls on pollution generated in consumption of particular commodities. Since product standards apply equally to products from any source, whether the competitive position of developing country suppliers is improved or worsened depends on whether the additional costs of meeting such standards are lower or higher in developing countries than in developed countries. Differences between commodities in the costs of achieving product standards may result in some substitution in consumption and, again, this may affect demand for developing country exports either favourably or unfavourably.

The actual nature of the effects of developed country pollution control costs on relative prices and patterns of comparative advantage depends, among other things, on the manner in which environmental policy is implemented in developed countries. In principle, levels of environmental control should be related to the social costs of environmental damage, and the cost of implementing those controls should fall directly on the polluting activities. It is possible, however, that adverse effects on the competitive position of individual industries, or on such things as regional unemployment, may deliberately be avoided by taking account of what industry can "afford to pay" in setting pollution controls, or by meeting pollution control expenditures from general government revenues. Other possibilities are that trade barriers may be increased to protect domestic industries from a loss of competitiveness due to high environmental control costs or, indeed, that product standards ostensibly imposed for environmental reasons may, in fact, be designed to favour domestic producers. Such policy approaches will, of course, distort the effects of developed country environmental policy on trade and investment, as well as reducing the welfare gains to developed countries themselves.

Similarly, the impact on developing countries will depend on the sorts of environmental policies which they elect to pursue. The broad generalization that environmental controls in developing countries will be less stringent than those of developed countries is based on one or both of the following arguments. First, where developing countries have a smaller concentration of polluting activities, the capacity of the environment to absorb pollutants without damage may be greater than in developed countries. Secondly, a given amount of physical damage to the environment may be perceived as imposing smaller costs in low income countries where, in comparison to the availability of material goods, environmental amenity is relatively abundant and, therefore, has a relatively low value placed upon it.

/Clearly

Clearly, the extent to which these arguments apply to individual developing countries varies considerably, being influenced by such factors as geographic and climatic conditions, population density, degree of industrialization, level of per capita income etc. Thus, general propositions about the effects of developed country environmental policy on developing country trade must be treated with caution when applied to individual developing countries. Moreover, environmental controls in developing countries may not reflect the true costs of environmental damage in those countries. On the one hand, relatively lax controls may reflect a lack of information about the nature of environmental damage, rather than a low valuation of that damage.[4/] On the other hand, the increasing tendency for multilateral and national suppliers of development finance to take account of environmental effects in their evaluation of projects may lead to the imposition of environmental standards which are more appropriate to developed countries than to the particular circumstances of the developing countries concerned.[5/]

It has not been possible, in the preparation of this paper, to assess levels of environmental controls in individual developing countries nor to make judgements about the importance of the sorts of distortions described in the preceding paragraph. Given this limitation, our general approach is to assume that developing countries all require and adopt very low levels of environmental controls, so that the bias in the analysis is towards exaggerating the effects of developed country environmental policy on patterns of comparative advantage and trade.

A separate strand of argument relates not to the sorts of relative price effects discussed above, but to more general macroeconomic effects of environmental protection policy in developed countries. Here, the concern of developing countries is that the shift of resources into abatement of environmental damage might reduce the level, or rate of growth, of real income in developed countries, and that such a slowdown in income growth might be transmitted to developing countries through a dampening effect on trade expansion.

The principal focus of attention in this study is on the trade effects of environmental controls applying to production, with particular reference to the production and processing of raw materials. First, however, we present a

/brief

4/ For a discussion of this issue, see B.I. Castleman, "The export of hazardous factories to developing nations" (Washington, 1978), (mimeo).

5/ This concern was expressed in a report on development and environment, United Nations Conference on the Human Environment, Founez, Switzerland, 1971, but it is arguable that the traditional emphasis in aid programmes on eradication of disease and high rates of infant mortality has been a long-standing example of the same phenomenon.

brief review of the analytical and empirical evidence relating to general resource allocation and macroeconomic effects, and to the effects of the introduction of product standards, on trade between developed and developing countries.

II. GENERAL RESOURCE ALLOCATION AND MACROECONOMIC EFFECTS OF ENVIRONMENTAL POLICY

Pollution control measures may impact on the real income levels of developed countries, as conventionally measured, in two distinct ways - in consequence of the need to divert consumption away from material goods towards non-marketed environmental goods, and as a result of any increase or decrease in unemployment which derives from the implementation of environmental policy.

The first of these only appears as a reduction in real income because of the failure of conventional measures to include benefits of increased environmental amenity. However, a shift of resources in developed countries away from production and consumption of material (and generally tradeable) goods towards environmental (non-tradeable) goods might be expected to have some effects on the trade of those countries with the rest of the world. Of particular interest in the present context are the possible effects on the terms of trade of the developing countries.6/

Later parts of the paper are concerned with the impact of direct relative price changes due to environmental controls. For the present, we abstract from these and focus on the more general implications of the resource reallocation from material to environmental goods in developed countries. Thus, it is assumed that, within developed country markets, the immediate impact of environmental controls is to raise the prices of all final tradeable products by the same proportionate amount.

It is evident, given this condition, that there will be no change in the relative prices at which tradeables are exchanged in the international market (and, therefore, that there will be no change in the terms of trade of developing countries) if two further conditions hold. These are: (i) that all tradeables are final goods; and (ii) that internatinnal prices of tradeables are determined solely by supply and demand conditions in developed country markets. This last

/condition

6/ The terms of trade reflects the purchasing power of a country's exports, and is measured by an index of export prices relative to import prices. A deterioration in the terms of trade means that a given quantity of resources employed in export production yields a smaller volume of imported goods which can be consumed, so that real income is reduced.

condition requires that developing countries represent only a very small part of the total world market for all tradeables, so that variations in their production or consumption cannot have any significant effect on world prices.

Under this set of assumptions, which we may call Model I, the initial impact of developed country environmental policy will be to raise export and import prices for developing countries by the same proportionate amount. This has the same effect on resource allocation in developing countries as a currency depreciation, and can be analyzed in the same terms. Thus, if developing countries were already in a position of full employment and balance of payments equilibrium, the stimulus to expand tradeable goods production, both in order to increase exports and to replace imports, would generate exchange rate/inflationary adjustments which exactly offset the initial rise in tradeable goods prices. In that case, developed country environmental policy would have no effect, after these adjustments, on developing countries.[7/] [8/] On the other hand, if developing countries were originally in a position of balance of payments deficit and underemployment, the rise in tradeable goods prices due to developed country environmental controls would stimulate an increase in production of those goods in developing countries which would move them closer to full employment and balance of payments equilibrium.

Under the conditions of Model I, then, the reallocation of resources away from material goods towards environmental goods in developed countries will not affect the terms of trade of developing countries, and will benefit those countries only to the extent that their increased competitiveness allows them to achieve higher levels of employment or a more favourable balance of payments position than they were otherwise able to achieve.

Model II differs from Model I in that we relax condition (ii) (see above) and assume that exports to, and imports from, developing countries represent a significant part of developed country production and consumption of tradeables.

/Then

7/ That is, the pattern and volume of trade between developed and developing countries would remain unchanged, as would the terms of trade, and the reduction in developed country consumption of tradeables would be matched by a reduction in production of tradeables for domestic sale.

8/ The consequences of adjustment in developing countries through exchange rate appreciation or inflation may not be identical. Although an exchange rate appreciation will restore the status quo and leave the economy unaltered, erosion of the impact of increased tradeable goods prices through domestic inflation may not. That is, the inflationary process, once started, may be difficult to contain and may continue to pose a policy problem after the appropriate balance between traded and non-traded goods prices is restored. In that sense, it may not be precisely true that developed country environmental policy has no effect on developing countries.

Then, as developed countries reduce tradeable goods production and consumption, at constant relative prices, they must also reduce the volume of trade with developing countries. The reduced demand for developing country exports and the reduced supply of developing country imports will lead to a fall in the price of the former relative to the latter - that is, to a deterioration in developing country terms of trade. In effect, some part of the cost of environmental protection in developed countries will be passed on to developing countries through a reduced volume of trade and relative price changes which reduce the real purchasing power of their exports.

Finally, Model III relaxes condition (i) (see above) and it is assumed instead that, although final consumer goods make up the bulk of developing country imports, the bulk of their exports are raw materials. Since the reduction in developed country production of final material goods may be expected to reduce demand for raw materials in approximately direct proportion, the prices of raw materials will fall relative to those of final consumer goods.[9/] Consequently, developing countries specializing in the export of raw materials will suffer a deterioration in their terms of trade. It should be noted that this result will arise even if developing countries represent only a small proportion of total world production of raw materials - that is, independently of whether or not condition (ii) holds.[10/]

The three models developed above suggest that the general reallocation of resources away from material goods to environmental goods in developed countries will have adverse effects on developing country terms of grade, and on the volume of trade between developed and developing countries, except under the restrictive conditions of Model I. However, it may be useful to distinguish between developing countries whose production of tradeables is heavily concentrated on raw materials, and whose terms of trade will deteriorate in the face of a significant switch in developed country production and consumption away from material goods, and those which are principally engaged in producing final

/consumer

9/ This effect may partially be offset by an expanded use of raw materials in the production of pollution control equipment. It seems unlikely, however, that this would be very significant on a continuing basis.

10/ This is not precisely true, however, If developing countries are small suppliers of raw materials, and if the environmental control costs for raw materials production in developed countries are proportionately as great as for final consumer goods, developing country suppliers will not suffer any terms of trade deterioration. Our implicit assumption is that raw materials production has proportionately smaller pollution control costs than do final consumer goods, which is a slight anticipation of later discussion.

consumer goods. It may be reasonable to argue that the share of this latter group in total world production of consumer goods is, in general, still relatively small, so that the conditions of Model I may apply approximately and their terms of trade may not be significant affected directly. Indirectly, as importers of raw materials, these countries may benefit from any weakening of raw materials prices relative to consumer goods prices.

Summary of empirical evidence

While the preceding analysis provides useful background for our later discussion, the crucial question in the present context is how large the reduction in production and consumption of material goods in developed countries is likely to be. No definitive answer to this question can be given, but some indications can be drawn from various studies.

Figures published by the OECD (see table 1) suggest that expenditures on pollution control were less than 1 per cent of GNP for five developed countries in the period 1971-1975 and were expected to be around 1.5 per cent of GNP in the three countries for which data were available for the period 1976-1980.[11/] The notable exception to this pattern was Japan, where pollution control expenditures were estimated as representing around 4 per cent of GNP in the period 1971-1975.

It is probable, however, that these figures underestimate the importance of environmental control expenditures in the periods covered, since the data employed were not fully comprehensive. In the future, more ambitious environmental targets are likely to be set, but it is not clear that these will necessarily raise the proportion of GNP devoted to environmental control expenditures. In some measure, the levels of pollution control expenditures experienced in the 1970s represent an element of "catching up", which has involved a concentration of substantial new investments. Also, technological progress in pollution control may be expected to exert some downward pressure on future costs.

On balance it appears that, with the possible exception of Japan, the extent of the diversion of resources to provision of environmental amenity is not very substantial, and that it is unlikely that the general effect of this on trade between developped and developing countries would be significant.

/The

11/ Various other forms of presenting the data, for example, as annualized costs, given broadly the same results and are therefore, not presented here. See, however, M. Pòtier, "Economic impact of pollution control", Proceedings of Environmental Economics Conference (Canberra, Department of Science and the Environment, forthcoming).

The discussion, so far, has implicitly assumed that the diversion of resources in developed countries occurs under macroeconomic equilibrium conditions. In practice, however, the possibility exists that environmental control measures may lead to a faster or slower rate of growth of GNP, or to higher or lower levels of unemployment, than would otherwise have been achieved. Econometric models of the Japanese, United States, and Netherlands economies have been used to compare projections with and without the inclusion of pollution control expenditures.[12/] In the case of the Japanese study, dealing with the period 1971-1977, pollution control expenditures are not themselves defined as contributing to real GNP. However, the multiplier effects of those expenditures on aggregate demand lead to an increase in the rate of growth of real GNP in the initial three years.[13/] Subsequently, GNP growth is slower than would otherwise have been the case but, at the end of the period, real GNP remains slightly higher than the level which would have been reached without environmental control measures. The effects on the level of employment are virtually identical. It appears, then, that the relatively large diversion of resources to environmental control in Japan (see table 1) is more than compensated for by the stimulating effect on economic activity generally.

The results obtained from the United States model accord closely with those of the Japanese model. Again, environmental control expenditures have a mildly expansionary effect on real GNP and employment in the early years. Unlike the Japanese case, however, both variables subsequently drop below the levels predicted in the absence of environmental controls so that, in 1979, real GNP is almost 2 per cent below the baseline prediction (but 20 per cent above the 1974 level) and the unemployment rate is 4.8 per cent as compared to 4.4 per cent on the baseline prediction. By 1982 these divergences have narrowed, with real GNP only 0.16 per cent lower and unemployment only one point higher than the baseline projections.

/In

12/ S. Shishido, Macroeconomic Implications of Environmental Policies: the Japanese Experience (OECD, 1974); Chase Econometric Associates, Inc., The Macroeconomic Impacts of Federal Pollution Control Programmes, Bala Cynwyd, Pennsylvania, Dec. 1974; H. den Hartog, The Economic Impact of Pollution Abatement, Central Planning Bureau, occasional papers (The Hague, 1975).

13/ The Japanese model considers two levels of environmental policy. The "softer" policy accords closely, in terms of share of GNP allocated to pollution controls, with actual Japanese experience over the period. Interestingly, the results of the two policies are virtually identical over the full period, but the "harsher" policy has a greater initial stimulatory effect on output and employment.

In contrast to these results, the Netherlands model estimates that a comprehensive environmental programme over the period 1973-1985 would result in an absolute fall in production, not including pollution control activities themselves, of 5.1 per cent and a reduction in employment of 1.2 per cent.

Conclusions

Interpretation of these various results is made difficult by a number of factors. So far as impacts on employment are concerned, the models are only capable of indicating problems which may be found by governments in attempting to maintain acceptable levels of employment. A notable characteristic of the Netherlands model is that both the inflationary impact and the balance of payments effects of pollution control expenditures are negligible, so that the environmental programme does not carry any built-in constraint on the pursuit of macroeconomic policies designed to minimize the adverse effects on income and employment. Also, the comprehensive nature of the environmental programme assumed in the Netherlands model may substantially overstate the extent of the diversion of resources to environmental controls over the period studied.

While the results from the Netherlands model must cast some doubt on the generality of the Japanese and United States results, it seems unlikely that developed country environmental policies will have effects on real income and employment levels of a size which might be expected to impact significantly on trade between developed and developing countries. If anything, the expansionary effect in recent years suggested by the Japanese and United States studies might, by easing the effects of the general recession on unemployment levels, have allowed a stronger resistance to protectionist pressures in developed countries than would otherwise have been possible.[14/]

III. THE EFFECTS OF DEVELOPED COUNTRY PRODUCT STANDARDS

The imposition of regulations relating to products to be consumed or used has a long history. Aside from regulations ostensibly aimed at protecting consumers against misrepresentation, controls have been exercised to reduce the incidence of human, animal or plant diseases. In these latter cases, regulations have often been directed specifically at products supplied from overseas, with the intention of preventing the introduction of diseases

/or

14/ It may be that impacts on employment are more important from the viewpoint of developing countries than effects on the rate of income growth, since movement away from a liberal trading environment in response to generally high unemployment may have relatively severe effects on the developing world.

or pests not (or no longer) endemic to the importing country.[15] Beyond these more obvious health, hygiene and agricultural protection measures, controls reflecting concerns for the physical safety of consumers as well as broader environmental considerations have also been exercised for a long time.[16] However, as information relating to potential hazards to health and well-being has expanded, the range and complexity of product standards has increased substantially.

Even though countries imposing product standards may adhere to the principle that there should be no discrimination against foreign suppliers, there is a number of ways in which such standards are likely to restrict trade. It will generally be more costly for foreign producers to obtain information about standards applying; and the fact that their products or production processes cannot generally be inspected in advance of shipment increases uncertainties associated with trade.[17] Also, it may often be the case that the costs of inspection are greater for foreign supplied goods than for domestic products, both in terms of the official resources which need to be employed and in terms of delays suffered in the distribution of products.[18]

Information costs may be a substantial barrier to trade for an exporter whose market is divided between a number of countries, each of which adopts different product standards - especially if those standards may be subject to relatively frequent change. Equally, such circumstances may create significant problems for the achievement of sufficiently large production runs to allow economies of scale to be reaped.

/The

15/ Good examples are foot and mouth disease and typhoid, both of which have stimulated severe controls on many types of agricultural/foodstuff imports into developed countries free of those diseases.

16/ Although air pollution from motor vehicles is a relatively recent concern, it should be noted that regulations relating to noise pollution (compulsory fitting of silencers) have existed virtually since motor vehicles were first introduced.

17/ Alternatively, where inspection during manufacture is specified in the regulations no provision may be made for inspection of overseas facilities, so that imports are effectively excluded. One United States example is quoted by C. Pearson, Implications for the Trade and Investment of Developing Countries of United States Environmental Controls (New York, UNCTAD, 1976), p. 28.

18/ It should be noted, however, that if higher costs of inspecting foreign supplied goods are met from general revenue this will not only soften the impact of product standards on trade but will be an implicit subsidy to imports.

The general tendency for product standards to increase resistances to trade can be reduced by more detailed advance notification of standards, and by greater harmonization of those standards between the countries which apply them. However, just as the GATT rounds of multilateral tariff negotiations have made greatest progress in dealing with products of mutual interest to the major developed countries, it may be that harmonization of standards will advance most rapidly in areas where developed countries stand to gain significant reciprocal freedom of access.

Developed country product standards affect both the exports and the imports of developing countries. On the export side the most significant impact is on agricultural products, both because agriculture provides a large proportion of developing country exports to the developed world and because product standards in this area are relatively difficult to achieve in developing countries. Regulations relating to health and hygiene are clearly more difficult to meet in countries where the general standards of health and hygiene are low. Similarly, it may be more difficult to meet standards relating to pesticide residuals or contamination by pests in countries where the prevalence of such pests is very great. Although many of the regulations impinging on trade in agricultural products and foodstuffs have been in force for a considerable time, their increasing complexity may have serious impacts on agricultural producers not easily able to meet additional requirements.

Another area where product standards may impinge on the exports of developing countries is in the production of basic chemicals and plastics.[19/] Here, the concerns of developed countries are with the levels of toxic residuals which may be given off during the use of such products. In this case, however, it is not clear that the cost of meeting standards will be higher in developing countries than in developed countries, so that the main effects may be due to costs associated with information and uncertainty, as discussed above, and to a tendency for users of materials whose quality control costs are high to substitute away from use of those materials.

/Product

19/ V. Ranganathan, Environmental Policies and their Implications for Trade and Development: A Case Study of India (Geneva, UNCTAD, 1977). This study provides examples of problems encountered by Indian exporters in meeting product standards, and lists those Indian exports likely to be adversely affected - all of these are agricultural/foodstuff and chemical products.

Product standards applying to manufactured goods relate to such environmental concerns as air pollution, noise levels, and radiation emission levels, as well as to physical safety factors. Again, it is not obvious that developing country producers will face higher costs of meeting standards than do developed country producers. Moreover, the mutual interests of developed countries are likely to lead to a greater conformity of standards relating to manufactures, so that information costs may be much lower for developing country exporters of such goods.

However, developing countries are predominantly importers, rather than exporters, of manufactures. Consequently, the main effect of developed country product standards will be to influence the nature of the goods available for purchase by developing countries. Given the large economies of scale in manufacturing, developed country producers are unlikely to employ different product standards for sales to developing countries, so that the standards judged desirable in the developed world are likely to be imposed on developing countries whether or not they accord with the needs of those countries. To the extent that developing countries have to import manufactures which are of higher environmental "quality" (and are, consequently, more expensive) than their own requirements would dictate, they will suffer adverse effects from developed country controls.

Finally, the possibility exists that product standards related to environmental considerations may be used deliberately as devices for the protection of domestic industry in developed countries. This may arise through the setting of standards which are unnecessarily difficult for foreign suppliers to meet, or through the establishment of administrative procedures which substantially favour local producers. While it is not possible to be certain about such matters, one United States study suggests that recent United States product standards do not seem to have been used as covert restrictions on international trade.[20/]

/Evaluation

20/ Pearson, op. cit., p. 28. Pearson notes, however, that more long-standing United States health and safety standards are perhaps used to restrict trade. This is, almost certainly, true of many other developed countries.

Evaluation of the effects of developed country product standards on the trade of developing countries would require a detailed commodity-by-commodity, country-by-country approach. However, it seems clear that the effects are likely to be adverse for all developing countries. The only cases where the effects will be favourable are where the costs of achieving product standards are lower in developing countries than in developed countries or where products exported by developing countries, and not themselves subject to environmental standards, are close substitutes for developed country products subject to standards. Neither of these cases seems likely to be quantitatively important.

The developing countries likely to be most seriously affected by product standards are those which are heavily dependent on exports of agricultural products, particularly foodstuffs, and which rely on imports from developed countries for supplies of industrial machinery and manufactures. These countries are likely to face the greatest difficulty in meeting standards relating to their exports, and to suffer most from "imposed" standards in excess of their own requirements on imported goods.

/IV.

IV. PRODUCTION POLLUTION CONTROLS AND EFFECTS ON COMPARATIVE ADVANTAGE AND THE TERMS OF TRADE OF ESCAP DEVELOPING COUNTRIES

As indicated in part II, the general reallocation of developed country resources away from material goods towards environmental goods is unlikely to have significant effects on trade with developing countries. However, these general effects were examined in the context of a model in which relative prices of tradeable goods were not directly affected by environmental policy, and where indirect effects would arise only in response to changes in the over-all volume of trade between developed and developing countries. In this part we turn attention to the more important, direct relative price effects of pollution control costs which differ between activities.

The first section provides an analytical treatment, and the second a brief outline of environmental control strategies in three developed countries of importance to ESCAP developing countries. With this background, we then present data on pollution control costs by industry and assess the broad implications for possible shifts in international competitiveness and relocation of industry. The last section attempts to provide estimates of the effects of developed country pollution control costs on the terms of trade of eleven ESCAP countries.

Analytical framework

For simplicity, at this stage let us suppose that the pattern of pollution control costs is the same for all developed countries, and that no such costs are incurred in developing countries. We assume, also, that the costs of controlling pollution are borne wholly by the activities generating that pollution, so that those costs are reflected in prices charged to purchasers of the output.[21/] Lastly, we again assume to begin with that all tradeable goods are final products.

The initial effect of introducing production pollution controls in developed countries is to reduce the competitiveness of their production in all activities subject to controls. However, competitiveness will be reduced more strongly in production of those commodities whose

/pollution

21/ This is the "polluter pays principle" as understood by policy-makers, even though, in fact, the polluter only pays for the amount of pollution abated and not for amount still generated - see section on "Pollution control policies ...", below.

pollution control costs are relatively high and the pattern of developed country comparative cost advantage will shift away from these goods towards goods whose pollution control costs are relatively low. Thus, unless the balance of payments positions of developed countries are to deteriorate permanently relative to those of developing countries, or unless the adverse balance of payments movements in developed countries are offset by restrictions on trade or capital flows, developed countries must expand their exports of commodities whose pollution control costs are relatively low in order to finance greater imports of commodities whose pollution control costs are relatively high.

The importance of this is that, in the long run, we should expect both a relocation of relatively polluting industries from developed to developing countries and a relocation of relatively non-polluting industries from developing countries to developed countries. It follows from this that we cannot deduce, a priori, that developing countries gain or lose from the international relocation of industrial activity resulting from developed country environmental policy. It is necessary to establish whether the terms of trade of developing countries are favourably or unfavourably affected.

Suppose, first, that the industries whose pollution control costs are relatively high in developed countries produce goods of which developing countries are already net exporters, while the industries with relatively low pollution control costs produce goods of which developing countries are net importers. Then the effect of developed country pollution controls will be to raise the prices of developing country exports, relative to the prices of their imports - that is, to improve their terms of trade. The relocation of relatively polluting activities in developing countries in response to the terms of trade movement, will both increase their degree of trade specialization and their gain from trade.

On the other hand, if the reverse condition holds so that developing countries are initially net importers of commodities whose production is subject to relatively high pollution control costs in developed countries, the effect of developed country pollution controls will be to raise the prices of developing country imports relative to the prices of their exports. This deterioration in developing country terms

/of

of trade will reduce their degree of trade specialization, as a result of the incentive to substitute domestic production for imports, and will also reduce the extent of their gain from international trade.[22/]

In practice, of course, the question will not be as clear-cut as this. Any given developing country may be a net exporter of some commodities whose production is relatively polluting and a net importer of others; and the circumstances of individual developing countries will vary widely. In some cases, also, the relative price shifts may be so great that developing countries become net exporters of commodities of which they were previously net importers.[23/] Such reversals in the pattern of trade specialization are, in a sense, a combination of a deterioration and an improvement in the terms of trade.[24/] Whether or not this increases or reduces the gain from trade depends on which effect dominates.

Aside from the direct effects of pollution control costs on relative commodity prices, there may be indirect effects due to changes in relative factor prices in developed countries. Where pollution control requires substantial investments in capital equipment, this will raise the demand for capital in developed countries relative to the demand for labour, with the effect that capital becomes relatively more expensive and all capital-intensive commodities become relatively more costly to produce. It is a reasonable generalization that developed countries tend to export capital-intensive products and import labour- or natural-resource-intensive products. Thus, a relative increase in the price of capital in developed countries may be expected to raise the prices of developing countries' imports and to cause their terms of trade to deteriorate. Such an indirect effect may strengthen, or partially offset, the direct effects on the terms of trade of pollution control costs.

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22/ For any given deterioration in the terms of trade, the welfare loss will be smaller the more resources are induced to move away from export production to import substitution by the change in relative prices.

23/ The reverse is also possible, but extremely unlikely.

24/ That is, the terms of trade deteriorate as the price of the good rises to the point where it is no longer imported. Beyond that point, further price increases which stimulate export production represent an improvement in the terms of trade.

Let us now relax the assumption that all traded goods are final products and, specifically, consider the situation of developing countries which are exporters of raw materials. The trade of these countries may be affected by environmental control costs in either the production or the processing to final products of raw materials. If, compared to control costs generally, environmental control costs are relatively high in processing and relatively low in the production of raw materials, developing countries will tend to become less specialized in primary raw materials production but more competitive in the processing activity. Clearly, the opposite will occur when control costs are relatively high for raw materials production, but relatively low for processing.

Further effects on developing country raw materials producers may arise from substitution between alternative raw materials in production processes, from substitution of recycled products for primary raw materials, or from substitution in consumption between products using different raw materials as inputs. These substitution possibilities may arise because different raw materials have different levels of environmental control costs associated either with their production or with their processing to final products. Recycling could be stimulated either by environmental control costs incurred in producing raw materials, or by higher environmental costs being incurred in using primary raw materials than in using recycled products.

The general effects of such substitutions would be that developing countries exporting raw materials whose demand declined would, other things being equal, suffer a deterioration in their terms of trade, while countries exporting raw materials whose demand increased would gain an improvement in their terms of trade.

One circumstance which could arise might be that high pollution control costs significantly increased the competitiveness in processing of a developing country raw materials producer, but also led to a substantial substitution away from the use of that raw material (or, more accurately, from products based on it) in developed countries. The developing country might then find itself exporting a larger volume of the processed product, but producing a smaller quantity of the raw material at a lower price. While the increased competitiveness in processing would represent an improvement in the terms of trade (unless the developing country was previously a net importer of the processed product),

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the fall in the raw material price clearly would represent a terms of trade deterioration. Thus, it is possible that a developing country might gain over-all from a situation in which the costs associated with lower output and price of its raw materials were offset by benefits accruing from increased processing of those raw materials - but this is not by any means inevitable.

As noted earlier, the analysis requires some qualification. First, if developing countries have unemployed resources and are in balance of payments deficit vis à vis developed countries before the implementation of environmental policy, the relocation of industrial activity towards developing countries may be uni-directional, although still relatively stronger for industries with higher pollution control costs. Although the benefit, or loss, to developing countries will still depend on the terms of trade impact, some degree of terms of trade deterioration may be an acceptable cost of achieving higher employment and an improved external payments position.25/

The second qualification relates to the assumption that the adverse shift in the balance of trade of developed countries is not offset by capital movements. The concern, here, would be that developed country governments might respond to an emerging payments dificit vis à vis developing countries not by changing exchange rates but by restricting overseas investment and aid flows.

Thirdly, the analysis assumes that the impact of pollution control costs in developed countries is not offset, or partly offset, by policies designed to protect polluting activities against a loss of competitiveness. If, for example, developed countries raised tariff barriers to avoid increased import competition from developing country production, any favourable terms of trade effects that developing countries might have enjoyed would be reduced.

To the extent that policy approaches of the sort described in the last two paragraphs are adopted by developed countries, gains to developing countries from the effects of developed country environmental policy will be diminished or greater losses incurred.

/Pollution

25/ Of course, this is true only if full employment and balance of payments equilibrium could not otherwise have been achieved by appropriate macroeconomic and exchange rate policies.

Pollution control policies in developed countries

In following up the analysis of the first part of this section, it is relevant to consider some aspects of the nature of environmental, and associated, policies in developed countries. This brief review is based on the situations of the United States, Japan and Australia - the first two countries because of their importance in trade with ESCAP developing countries and because their policies may be considered representative of future, if not current, trends in developed countries: the third country because the different nature of its economy allows the possibility of different emphases in environmental policy and because of its relative importance in the regional context.

Although economists have consistently argued that environmental controls are most efficiently exerted through the use of pollution taxes, where each polluter is taxed according to the marginal social cost of the damage created but is left free to determine the amount and method of pollution abatement, policy-makers have almost universally preferred to adopt direct regulations about quantities of pollutants to be permitted or about technologies which may be employed.[26/] Although it is not possible to quantify the extent of the distortion, this will mean that a given amount of pollution abatement in an area (e.g. reduction of sulphur dioxide in the air) will be achieved at higher cost than is necessary and will lead to a misallocation of resources between activities.[27/]

While developing countries have no immediate concern with the efficiency, or otherwise, of developed country environmental policy, it is perhaps worth noting that future adoption of more efficient policy approaches could lead to a reduction in pollution control costs over-all and have possibly different relative price effects between industries.

The emphasis placed on abatement of particular forms of pollution varies somewhat between countries, partly in response to different industrial structures and partly as a result of different geographical conditions. In Japan, one estimate suggests that costs of abating air pollution would account for 69 per cent, and costs of abating water pollution 22 per cent, of the over-all product price

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26/ This policy approach is due largely to a view that a taxing strategy is more administratively complex. In fact, efficient environmental control by direct regulation requires substantially more information than the efficient use of pollution taxes.

27/ This arises because direct controls usually allocate pollution abatement equally between activities, relative to some indicator such as volume of waste gas emission, whereas there is no necessary economic rationale for this.

increases resulting from pollution control costs.[28/] In the United States, expenditures on air and water pollution abatement are estimated to be roughly equal, and, together, to account for about 85 per cent of total pollution control expenditure.[29/] Comparable data for Australia are not presently available, reflecting a later and less urgent concern over industrial pollution. Although similar legislation relating to air and water pollution exists in some form in all three countries, levels of standards set and the extent of variations in standards between locations differ between them. The major air pollution concern in Japan has been the emission of sulphur dioxide by industry, with the result that, although stringent controls on automobile emissions are enforced, these are relatively much less important. In the United States and Australia, on the other hand, control of automobile emissions is of as great, if not greater, importance than industrial air pollution. In Australia, particularly, air pollution problems are confined to the few large cities and substantial possibilities exist for industrial concerns with large waste gas emissions to avoid severe controls by locating away from metropolitan areas. Although such regional variations in control standards also exist in Japan, they are much less important compared to the over-all levels of control imposed.[30/]

A further possible area of broad difference between the countries lies in the relative emphasis placed on conservation of the natural environment, and the impact that this has on natural resource based industries such as mining and forestry. This has been a prominent area of policy discussion in both the United States and Australia. Despite sometimes severe restrictions in the United States, the impact of environmental controls on natural resource industries is not great compared to the impact on a number of areas of manufacturing industry. In Australia, however, the rapid growth of environmental controls over mining, in particular, may mean that this sector is relatively greatly affected, given the more moderate levels of control applying to manufacturing in Australia.

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28/ S. Shishido and A. Oshizaka, "Econometric analysis of the impacts of pollution control in Japan", paper presented to an International Conference for Environmental Protection, Tokyo, May 1976.

29/ C. Pearson, op. cit., p. 14.

30/ For a comprehensive review of Japanese air pollution controls, see M. Furuichi, "Sulphur reduction policy in Japan", Technocrat, vol. 11, No. 9, September 1978.

All three of the countries broadly adopt the "polluter pays" principle of pollution control, whereby control costs are borne by the activities generating environmental damage. However, in both Japan and the United States there are mechanisms available for offsetting part of the costs borne by industry. In Japan, these include government expenditure on technological development of pollution control systems, either directly or through subsidies provided for R and D undertaken by private companies; accelerated depreciation for company taxation purposes on pollution control investments; real estate tax reduction or exemption; and concessional loans for the financing of pollution control investments. While this appears to be a formidable list, the subsidy equivalent is in total probably not very great. One study has suggested that accelerated depreciation and concessional loans might together have provided a subsidy equivalent to 1.5 per cent of total pollution control investment in 1975.[31/]

The range of possible subsidy instruments in the United States is broadly the same as in Japan. However, accelerated depreciation is not very widely available and the most important element is the provision for loans to be raised through Industrial Revenue Bonds, interest on which is tax free. Although no estimates are available of the subsidy equivalent of such concessional finance, it is likely to be substantially greater than the estimates made for the Japanese case.[32/] In Australia, the large number of bodies responsible for environmental control makes it difficult to assess the importance of incentives offered. However, there are no general assistance schemes and the main subsidy elements may be indirect, as in the case of subsidies aimed at promoting decentralization but which can also serve to subsidize movement of polluting industries away from metropolitan areas.

Even though industry does bear most of the cost of environmental controls, difficulties in doing so for particular activities may influence the levels of controls set. To the extent that similar activities in developed countries are faced with similar control policies, the main difficulties in meeting pollution control costs may arise through competition from developing country producers. Then, if such difficulties are allowed to constrain environmental policy the effect will be to limit areas of possible gain to developing country exporters.

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31/ Environmental Policies in Japan (Paris, OECD, 1977), pp. 74-75.

32/ If the whole of the taxation advantage were reflected in a lower interest rate to the borrower then, with a tax rate of 30 per cent, market interest rate of 10 per cent, and a constant rate of amortization over 5, 10 or 15 years, the subsidy equivalent of finance through Industrial Revenue Bonds would be 7.5, 12.5, and 16.5 per cent, respectively, of the sum invested. C. Pearson, op. cit., quotes estimates suggesting that up to 50 per cent of air and water pollution control investments may ultimately be financed through Industrial Revenue Bonds.

In the case of the United States, Pearson suggests that delayed implementation of environmental standards is quite likely where significant adverse effects on particular activities are anticipated.[33/] In the Australian situation, such delays or revisions of standards required appear to be relatively common.[34/] To date, it is less likely that such effects have been felt in Japan since the environmental issue has been considered extremely urgent and general standards have been applied across the board for the major pollutants. However, now that the immediate pollution problem has been substantially redressed, further environmental measures may sometimes be constrained by consideration of such issues as impacts on sectoral employment.

Finally, as suggested earlier, it is important to consider whether developed country trade policy may be used to offset the impact of pollution control costs on domestic industry. Although there is no evidence of this at present in any of the countries examined, it is not always possible to judge the extent to which arguments for increased protection are, in fact, a response to pollution control costs even though this reason is not given.[35/] In one area of the United States environmental legislation specific provisions are made for the possible use of border tax adjustments to compensate for lower environmental costs borne by foreign suppliers.[36/] Although no action has yet been taken under these provisions, it is disturbing that the United States position in the multilateral trade negotiations has included proposals for countervailing duties to offset international variations in pollution control costs. The main adverse impact of such trade restrictions would undoubtedly fall on developing countries.

/Pollution

33/ Ibid., p. 12.

34/ It should be noted, however, that in the setting of standards policy-makers have to take account of the economic costs of those standards as well as the benefits. The problem with this approach (compared to a pollution tax strategy) is that environmental policy-makers may need to become involved in assessing social costs implied by structural adjustment problems - see Ben Smith, "International trade and environmental policy", Proceedings of a Conference on Environmental Economics (Canberra, Department of Science and the Environment, forthcoming).

35/ Jan Tumlir, for example, suggests that many polluting industries in developed countries are actively campaigning for protection but "are conspicuously not using the pollution-control cost argument" believing it to be "counter-productive in increasingly environment-minded societies" - "Pollution control and the theory of trade", in I. Walter (ed.), op. cit., p. 14.

36/ Federal Water Pollution Control Act Amendments, 1972 (Public Law 92-500), Section 6.

Pollution control costs and effects on comparative advantage

The pollution control costs examined in this section are for the United States and Japan, the countries for which the most comprehensive data are available. Since these countries have more stringent environmental control policies than developed countries generally, the data may overestimate levels of pollution control costs for the developed world as a whole. However, the importance of these two countries in trade, particularly for developing ESCAP countries, and the fact that environmental controls in other developed countries are likely to be more stringent in future, suggest that the degree of over-estimation may not be very important.

Tables 2 and 3 present data on capital costs due to pollution control investments in the United States and Japan. It is evident that, for industry as a whole, pollution control has represented a significantly greater proportion of total investment in Japan than in the United States. However, the most recent data suggests a degree of convergence, and it is likely that the high Japanese values in 1974-1976 reflect a short-term bunching of investments required to meet the sharply increased severity of environmental legislation enacted in the late 1960s and early 1970s. Nevertheless, it may be that pollution control investment in Japan will continue to be around one and a half times as large a proportion of total investment as in the United States.

With 5-6 per cent of United States business investment and 8-9 per cent of Japanese business investment devoted to pollution control, the additional demand for capital is not insignificant. It is possible that this may affect the cost of capital generally, with effects of the sort outlined in the previous section, but this is not likely to be quantitatively important.

In the United States non-ferrous metals, paper and pulp, and iron and steel have clearly the highest proportions of capital devoted to pollution control, while petroleum, chemicals, stone, clay and glass, and electric power form a second group significantly ahead of other industries. The Japanese rankings match those of the United States with some notable exceptions. First, thermal power generation has easily the largest proportion of capital devoted to pollution control, while petroleum is second in the ranking ahead of paper and iron and steel. Both of these are explained by the importance attached to the reduction of sulphur oxide emissions in Japanese environmental policy, the high ranking of petroleum reflecting the large scale installation of de-sulphurising equipment. The other notable difference between the United States

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and Japanese data is in mining, where pollution control capital costs are quite small in the United States but higher than for paper or iron and steel in Japan. However, since Japan's output of tradeable mine products (excluding coal which has capital costs for pollution control comparable to the United States figures) is extremely small, little emphasis need be placed on this result.

While tables 2 and 3 give some indication of the industries worst affected by pollution controls, a more accurate picture is given by examination of pollution control costs as a proportion of total production costs. A number of estimates has been prepared for the United States, at different levels of aggregation and using data for different periods.[37] In this study, estimates made by Ingo Walter have been employed, principally because the high degree of disaggregation makes them more useful for matching with trade data.[38]

Walter's estimates are presented in table 4. The direct cost of environmental controls is defined as costs incurred in the production process in which the industry is engaged, while the total cost also includes indirect costs passed on from other activities in the prices of purchased inputs. Both direct and total costs are expressed as a percentage of value added and as a percentage of final sales price for each activity.

If all inputs into each activity were tradeable products, we should really only be interested in the data presented in the first column. That is, we could assume that indirect cost increases could be avoided by substitution of imports for domestically produced inputs, and we could assess the relative effects on competitiveness by looking at the proportion of value added in each activity required to meet environmental controls relating to that activity.

In fact, however, various non-tradeable goods enter as important inputs into production processes and some of these - most notably electric power - carry significant environmental control loadings. The ideal measure would include indirect costs due to controls on non-tradeable input production but not those due to controls on tradeable input production, but the data do not allow this. Fortunately, the ranking of industries is much the same for all of the measures given in table 4.

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37/ For a survey of the most important of these, see Pearson, op. cit.

38/ Unfortunately, these estimates relate to the period 1968-1970 so that they may no longer be representative of the United States position. On the other hand, given the relatively early implementation of environmental controls in the United States, these estimates may reflect broadly the current position in developed countries as a whole.

A further problem of the data is that direct costs include costs associated with the need to meet product standards and, in the case of scientific instruments, the costs of producing control equipment. Clearly, such costs are not relevant to consideration of the impact of pollution controls on competitiveness with foreign producers of the same products. This difficulty needs to be borne in mind in interpreting the data.

From the first column of table 4 it can be seen that petroleum, chemicals (including paint and plastics), non-ferrous metals, stone and clay products, and paper and paper products bear relatively high direct costs of pollution controls, and this accords with the earlier data on capital costs. Also in the same category, however, are found scientific and controlling instruments, optical equipment, motor vehicles, and livestock. For the first three of these, and possibly also the fourth, this is insignificant measure due to the data problem described in the last paragraph. The next most seriously affected industries appear to be iron and steel, coal mining, leather products, agriculture, and various machinery producing activities. Again, it seems likely that the values for machinery, and possibly agriculture, are swollen by costs associated with the need to meet product standards.

When indirect costs are included (third column of table 4), almost identical results are found. The most notable differences are that ordnance and accessories and household appliances move sharply up the ranking, to be as adversely affected as paper and iron and steel. In both cases, but most clearly for ordnance and accessories, it seems likely that the high indirect costs are associated with pollution control loadings on tradeable inputs and could be avoided by substitution towards imported inputs. Consequently, it is not clear that Walter's conclusion that "the United States competitive position may be (adversely) affected in industries such as ordnance and accessories ..." is warranted.[39/]

When direct and total costs are considered as proportions of final sales prices, the relative impact on different industries remains as described above. For the most affected industry, petroleum refining, the price increase is 3.73 per cent due to direct costs and 4.58 per cent due to total costs. In the case of the least affected industry, wooden containers, the comparable figures are 0.05 per cent and 0.56 per cent, respectively. It is evident, then, that the United States data do not suggest very substantial absolute or relative price effects due to environmental controls.

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39/ I. Walter, "The pollution content of American trade", Western Economic Journal, vol. XI, No. 1, 1973, p. 68.

Table 5 presents estimates of total (direct plus indirect) pollution control costs as a percentage of final sales prices for Japanese industry, under two alternative scenarios - a "softer" policy (A) and a possible "harsher" policy (B). Although these estimates relate only to capital costs of pollution control, it is noticeable that even under the "softer" policy impacts are generally greater than Walter's estimates for the United States. Also, the degree of dispersion around the mean is considerably greater in the Japanese case, reflecting a more substantial impact on relative prices. However, some of the very low values are difficult to account for, especially those shown for mining under items 8 - 11 which seem inconsistent with the high pollution control capital costs for mining reported in table 3.

One significant factor in the Japanese results not reported in the table is the relatively high environmental control cost loading for electric power: 6.2 per cent under the "softer" policy and 11.8 per cent under the "harsher" policy. Clearly, industries requiring substantial use of electricity in Japan will have relatively high indirect costs of environmental controls.

By and large, the most seriously affected industries in Japan are the same as those observed from the United States data, although their ranking is somewhat different. Primary iron, leather products, and pulp and paper head the list, with petroleum products, ceramics, automobiles, fisheries, chemicals and non-ferrous metals also being significantly affected. The relatively high value for automobiles presumably is influenced by product standard requirements, and this may also explain the values shown for manufactured sea foods and meat and dairy products.

Although there are problems in interpreting some of the data, relatively high pollution control costs are consistently evident for activities engaged in the processing of raw materials. This should not be surprising, since these are activities in which there is a substantial direct or indirect use of fuels, with consequently large air pollution problems, and where the difficulties of disposing of residual wastes are often considerable. A first conclusion, then, would seem to be that lower pollution control costs in developing countries will most favourably affect their competitive position as processors of primary raw materials. This issue is taken up more fully in part V of the study.

It is less easy to draw conclusions about the sorts of activities which have relatively low pollution control loadings, and where the relative competitive position of developing countries may deteriorate as discussed in

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the previous paragraphs. There is some suggestion that primary production and labour-intensive, light manufacturing industries are less affected than the more capital- and energy-intensive manufacturing activities. If this were generally true, the competitive position of developing countries would be adversely affected in areas where their comparative advantage was otherwise most substantial, and this would tend to dampen expansion of trade specialization and retard developing country growth. However, the data are ambiguous in two important areas. The Japanese estimates show environmental control cost loadings for primary production (product categories 1 - 13 in table 5) which are very much lower, relative to other activities, than is the case in the United States (product categories 1 - 10 in table 4), whereas the opposite is true for textiles and apparel (product categories 18 - 21 in table 5; and 16 - 19 in table 4). Thus, judgements about the relative positions of these activities, and about the impact of developed country pollution controls on the competitive positions of developing countries specializing in their production, depend in significant measure on which estimates we take to be representative of developed countries generally.

In the case of mining, it seems reasonable to place more emphasis on the United States data, since mining is relatively unimportant in Japan and because of the apparent inconsistency in the Japanese data referred to in the above paragraph. Moreover, it is unlikely that the United States estimates take full account of environmental control costs associated with conservation of the natural environment and which impact strongly on the mining industry.[40/] Thus, the relative importance of environmental control costs for mining activities may be greater than is suggested by either set of estimates.

It should also be noted that considerable variations in the impact of pollution control costs may be concealed by the aggregation of activities into industry sectors. This is likely to be of particular importance in the "chemicals" industry, where there are substantial differences in the pollution problems, and costs of abatement, between different products and processes. The averaging necessary to produce the estimates shown in tables 4 and 5 consequently understates the relative price effects of pollution controls and, therefore, the extent of changes in developing country comparative advantage in specific products.

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40/ Concerns over conservation impact on mining both through costs incurred in adopting techniques that would otherwise not be used and in rehabilitation of disturbed areas and through costs associated with delays and uncertainties during the (sometimes quite long) periods when the environmental implications of projects are being assessed.

To conclude this discussion of the impact of developed country environmental controls on the trade of developing countries generally, brief reference should be made to an empirical study conducted by Pearson.[41] Using estimates of the effects of pollution control costs on prices in the United States, together with estimates of the United States import demand elasticities, Pearson sought to assess the likely increase in the United States imports under fixed exchange rates. The over-all increase in imports for the products included was just over 2 per cent but, taking account of the increased competitiveness of developing countries vis-à-vis third country suppliers (whose pollution control costs might be expected to be similar to those experienced in the United States), Pearson suggests that the United States' imports from developing countries might be higher by as much as 4.6 per cent on average in the period 1973-1977 and 4.1 per cent on average from 1978 to 1982. Above average percentage increases were indicated for lumber and wood products, fabricated metal products, paper and paper products, stone, clay and glass, non-ferrous metals, non-electrical machinery, petroleum refining, rubber and miscellaneous plastics, iron and steel, chemicals (1973-1977 only), and textile mill products (1978-1982 only).[42] In the cases of fabricated metal products and non-electrical machinery the high percentage increases in imports were principally due to high assumed import demand elasticities. In absolute terms, the greatest increases in the United States imports from developing countries were in petroleum refining, non-ferrous metals, lumber and wood products, textile mill products, electrical machinery, and food and kindred products, reflecting the current relatively large shares of developing countries in the United States imports of these products.

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41/ C. Pearson, op. cit., pp. 22-24.

42/ It should be noted that the percentage price changes due to environmental controls used in Pearson's study differ from those reported in table 4. Most notably, lumber and wood products has an environmental control cost loading almost twice as high as any other activity, whereas in table 4 this activity has a relatively low environmental control cost loading.

The Pearson study is interesting in that it suggests that the impact of developed country environmental policy on trade with developing countries may not be insignificant.[43/] However, it has only limited value in indicating the products likely to be most affected, and therefore the developing countries most likely to benefit, since it is assumed that exchange rates remain fixed. If, for example, developing country currencies needed to be revalued on average by 1.3 per cent over the period 1978-1982 in order to counter the balance of payments effects of increased export demand, this would more than offset their competitive advantage due to the United States pollution control costs in nine of the fifteen product categories considered by Pearson.[44/] Included in this group would be chemicals, petroleum refining, iron and steel, stone, clay and glass, and non-electrical machinery. Clearly, with such a change in exchange rates, imports of these products from developing countries would be expected to fall rather than, as Pearson's study suggests, rising at average or above average percentage rates.

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43/ It should be noted that the study, and any generalization of it to embrace the simultaneous implementation of environmental controls in all developed countries, only takes account of one side of the effects. In addition to the increased penetration of developed country markets by developing countries there would also be reduced penetration of developing country markets by developed countries.

44/ Alternatively, exchange rates may remain fixed but increased demand for developing country production may generate inflationary pressures which similarly erode competitiveness.

Effects on the Trade of ESCAP Developing Countries

Pearson's results have been used to estimate the effect of the United States environmental controls on the Republic of Korea's exports, employment and income.[45] The change in Korean exports was estimated assuming that the Republic of Korea's share of each United States import category remained constant at the 1973 value. Impacts on employment and income were found by feeding the increased export values through an input-output table. Even without taking account of any exchange rate changes needed to maintain the United States balance of payments equilibrium, the estimated impacts were extremely small. Korean exports were found to increase by 0.3 per cent per annum in the period 1973-1977, with the corresponding increases in employment and GDP being 0.02 per cent and 0.03 per cent, respectively.

An alternative estimate of the impact of the United States environmental controls has been made for Thailand.[46] In this case it was assumed that the United States imports of the ten most pollution intensive industries would increase by $US 100 million each, and that the balance of payments impact would be offset by a similar increase in the United States exports for the ten least pollution intensive industries. Taking the effect on Thailand's trade to be proportional to Thailand's actual share of the United States imports of the relevant products in 1974, it was found that Thailand would suffer an over-all balance of payments deterioration and significant adverse impacts on employment and income. The essentially arbitrary assumptions about the impact of the United States environmental policy on the United States trade render these results highly suspect,[47] but they do demonstrate the importance of the United States balance of payments adjustments in determining the over-all impact on developing country trade.

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45/ Jong-Goo Park, "Impact of the United States environmental control on the Korean economy".

46/ Phisit Setthawong, "Impact of the United States environmental control on the Thai economy".

47/ Also the definition of pollution intensity used relates to physical quantities of pollution generated per dollar of final sales, rather than to control costs, and these may not give the same rankings.

It should be noted that the adverse impact of the United States environmental controls estimated for Thailand essentially reflects a deterioration in Thailand's terms of trade. That is, following the argument in section on "Analytical framework", part IV above, Thailand's comparative advantage in trade with the United States lies more strongly in commodities for which pollution control costs are relatively low than in commodities for which pollution control costs are relatively high. The remainder of this section gives explicit consideration to the terms of trade effects on eleven ESCAP developing countries of developed country environmental controls.

In general, it may reasonably be assumed that price levels in developed countries determine the prices at which developing countries are able to trade. Thus, price increases due to developed country pollution control costs increase the prices of developing country imports and exports of the products concerned. The over-all impact on developing country terms of trade will depend on whether, on a weighted average basis, export prices rise more or less than import prices. The weights used are the export and import values for the different product categories in 1974, and the over-all terms of trade effect is assessed by inflating each value by the appropriate percentage price change and comparing the aggregate percentage increases in export and import values.[48/]

Since pollution control costs result in differing absolute and relative price changes between developed countries, there is no unique set of price effects which can be used to analyze the impact on developing country terms of trade. However, the United States estimates given in table 4, referring to a relatively early period in the development of the United States environmental policy, and the Japanese estimates for the "harsher" environmental policy given in table 5 provide a range of possibilities within which the "average" outcome for developed countries may be expected to lie. Consequently, the terms of trade effects on the eleven ESCAP countries are assessed on the alternative assumptions that, first, the United States estimates and, second, the "harsher" Japanese estimates represent the price effects of pollution control costs in developed countries generally.

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48/ It should be noted that this procedure measures the terms of trade change as defined earlier (footnote 6), rather than the income terms of trade which reflects changes in quantities of imports and exports as well as changes in their prices.

The 1974 trade statistics for each of the developing countries were arranged to match the product categories used in the estimations of price effects for the United States and Japan. Table 6 presents this data, for the Japanese product classification, in a form which allows easy comparisons between the structures of trade for the eleven countries.

All but four of the developing countries covered are net exporters of basic primary products and net importers of manufactures. In the case of Papua New Guinea, three quarters of total trade is devoted to the exchange of primary products for manufactures while, for Indonesia and Fiji, this proportion is over 60 per cent.[49/] At the other extreme, almost one third of the Republic of Korea's trade, and over 20 per cent of that of Hong Kong and Singapore, involves the export of manufactures in exchange for primary product imports. India is, marginally, a net exporter of manufactures and a net importer of primary products - principally because of the relative importance of oil and grains in India's imports.

Tables 7 and 8 report the results obtained by multiplying export and import values in each product category by the percentage price increases estimated for the United States and Japan. Before discussing these results, however, some problems of the data and methodology should be commented upon.

The implicit assumption of the procedure adopted is that the actual export and import prices of the eleven developing countries in 1974 did not incorporate any effects of pollution control costs. If the reverse were true, and pollution control costs were fully incorporated into price levels, the logical procedure would be to deflate the trade figures by the relevant percentage price changes but this would not noticeably affect the results. The difficulty would be if pollution control costs were more fully reflected in the prices of some products than of others and, in particular, if they were more fully reflected in export prices than import prices, or vice versa. In the absence of any means of assessing the extent of distortions arising from differential existing impacts of pollution control costs, we merely note the possibility of some degree of bias.

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49/ The remainder of total trade is, of course, devoted to exchange of primary products for primary products or of manufactures for manufactures.

A second problem arises from the fact that the estimates of price increases are not restricted to the impact of production pollution controls, but also include costs of achieving developed country product standards - although the extent to which this is true of the Japanese estimates is uncertain. While developing country exporters of products to which standards apply may obtain higher prices, no improvement in their terms of trade is implied since additional resources are required to meet those standards. In general, however, price increases due to product standards are more likely to present a problem in the evaluation of effects on developing country import prices. Our assumptions that import prices will rise by the full amount of the developed country price changes due to product standards, and that this reflects a deterioration in developing country terms of trade, will be valid only to the extent that developed country product standards are imposed on developing countries. If, in fact, product standards incorporated in imports match the requirements of the importing country, our procedure overstates any adverse terms of trade effect.

Finally, our procedure assumes that developing country exports are competitive with developed country products in the category to which they are assigned, so that any increase in developed country product prices will be reflected in increased prices for developing country exports. However, where a particular developing country is heavily dependent on exports of a product which is not a close substitute for developed country products, this assumption may bias the results strongly towards showing a more favourable terms of trade effect than actually occurs. The most obvious cases where this may arise are in the exports of tea (Sri Lanka) and coffee (Papua New Guinea) and, to a probably smaller extent, rice (Thailand) and sugar (Fiji and Philippines). In order to take account of possible biases due to the non-competitiveness of these products with developed country products, the results shown in tables 7 and 8 have been computed with and without their inclusion. Another possible case where bias may arise is in the treatment of exports of natural rubber (Malaysia and Sri Lanka), but here the substitution with synthetics may be sufficiently close that the problem is not significant.[50/] Again, however, the calculations have been made with and without the inclusion of this product.

/Turning

50/ However, this presents a further problem of determining the appropriate product category for natural rubber - see last paragraph of page 15.

Turning now to the results, it can be seen that when the United States estimates of price effects are used (table 7) only Singapore enjoys an unambiguous improvement in the terms of trade. This result is due to Singapore's high degree of specialization in petroleum refining and is meaningful only to the extent that Singapore does not itself have significant pollution control costs for this activity. If, in fact, pollution control costs in Singapore were more than seventy per cent of the United States control costs, the apparent terms of trade improvement would be reversed.

The most notable aspect of the results shown in table 7 is that, although the terms of trade effects are generally negative, they are all very small and lie in the range $\pm$ 1 per cent. Moreover, there is no obvious pattern to the results, with the countries specializing in manufactures being neither more nor less adversely affected than the primary producing countries.

From table 7 we may conclude that, if Walter's estimates of price increases due to environmental controls in the United States were representative of developed countries as a whole, the impact on trade and welfare for the eleven ESCAP countries would be generally negative but scarcely significant.

This picture is altered radically when the Japanese estimates of the price effects of pollution control costs are applied to the trade data (table 8). Compared to the results shown in table 7, the terms of trade impact is substantially more favourable for the most industrialized country, the Republic of Korea, and to a lesser extent also for Singapore and Hong Kong. The positions of India and Sri Lanka deteriorate very slightly, but those of the more substantial net exporters of primary products deteriorate quite sharply.

The relatively greater pollution control costs for textiles and apparel in Japan have a significant impact on the results, accounting for about one third of the improvement in the position of the Republic of Korea. In the case of Hong Kong, the relatively high price increase for apparel is responsible for outweighing what would otherwise have been a less favourable terms of trade impact (by about 1 per cent) than that calculated from the United States price estimates. For India, however, the higher price increases for textiles and apparel are almost exactly offset by higher price increases for imports of heavy industrial goods. The position of Hong Kong, particularly, reflects our earlier comment that countries specializing in

/labour

labour-intensive manufactures and dependent on imports of products such as pulp and paper, chemicals, petroleum, iron and steel, and non-ferrous metals would be likely to be adversely affected by developed country environmental policy.

The significance of the favourable terms of trade effect shown for Singapore again depends on the level of pollution control costs for petroleum refining in that country. If those costs were 80 per cent of pollution control costs in Japan, the additional resources needed for pollution control would more than offset the apparent favourable movement in the terms of trade.

The relatively strong improvement in the terms of trade for the Republic of Korea results both from the greater relative price effects of pollution control costs in Japan and from the significant concentration of the Republic of Korea's exports on products for which price increases due to pollution control costs are relatively high. Although the Republic of Korea is a net importer of pulp and paper, chemicals, non-ferrous metals and automobiles, in aggregate it is a substantial net exporter of products for which price increases due to pollution controls exceed 2 per cent, with the result that the over-all terms of trade effect is clearly favourable.

Sri Lanka's position can be characterized broadly as follows. The large proportion of total trade devoted to the export of primary products (excluding rubber) in exchange for other primary products (chiefly grains and oil) results in no terms of trade impact using the Japanese estimates of price increases, since these are uniformly small for the products involved. Using the United States' estimates, the relatively high price increase for agriculture results in a favourable terms of trade impact for this exchange if tea is included in the calculation. However, if tea is excluded, the terms of trade impact is virtually eliminated. The remainder of Sri Lanka's trade essentially involves the export of rubber in exchange for a broad range of manufactures and, whether Japanese or United States estimates are used, the terms of trade impact of price increases due to pollution control costs is negligible for this exchange.

The possibility that rubber should be excluded from the calculations has been discussed earlier, and alternative results are presented in tables 7 and 8 for the countries which might be significantly affected. However, it may plausibly be argued that rubber should not only be included but should be allocated to the product categories plastic and synthetic materials (the United States) or basic chemicals (Japan), since these include the

synthetic materials with which rubber is most closely competitive. In both cases, these alternative product categories have greater price increases due to pollution control costs than does the category rubber products. If these adjustments are made in the calculations for Sri Lanka (with tea excluded), a terms of trade improvement of just over 0.6 per cent is obtained using either the United States or the Japanese price estimates.

When the same procedure is adopted for the calculations of the terms of trade effects on Malaysia, the slight terms of trade deterioration shown in table 7 is converted to a small terms of trade improvement of 0.5 per cent, and the terms of trade deterioration shown in table 8 is reduced to 0.5 per cent.

The difference between the results of table 7 and table 8 for the remaining countries is due, in large measure to the relatively low estimated price increases for primary products in the Japanese case. As noted in section on "Pollution control costs and effects on comparative advantage", part IV, the Japanese estimates of price increases due to environmental controls in mining are rather suspect and even the United States estimates may not incorporate the full price effects. Since this might be though to influence the terms of trade impacts for Indonesia and Papua New Guinea in particular, these have been recalculated substituting price increases for mining equal to one and a half times the United States estimates. The effect of this is to reduce the terms of trade deteriorations shown in table 8 to 2.1 per cent for Indonesia and 2.5 per cent for Papua New Guinea.

Summary and conclusions

The procedure used to assess the terms of trade impacts of developed country environmental controls necessarily has a number of shortcomings, so that the results cannot be viewed with complete confidence. Nevertheless, some clear patterns emerge which are consistent with our earlier reasoning and these are worth noting..

Whether United States' or Japanese estimates of the price effects of pollution controls are taken to be representative, the five countries most strongly specialized in the export of non-rubber primary products (Fiji, Indonesia, Papua New Guinea, Philippines and Thailand) suffer a clear deterioration in their terms of trade. Using the United States data, the magnitude of this deterioration is around 1 per cent while, using the Japanese data, it is between 2 and 3 per cent.

/If

If rubber is classified as a manufactured good, because of its competitiveness with manufactured synthetics, three countries (India, Malaysia and Sri Lanka) can be said to be neither specialized in primary production nor in manufacturing. The terms of trade of these three countries are affected only to a small extent by deveeoped country environmental policy. India suffers a slight terms of trade deterioration and Sri Lanka enjoys a small terms of trade improvement under both sets of calculations, while Malaysia's terms of trade improves by half a per cent using the United States price estimates and deteriorates by the same amount when Japanese estimates are used.

The position of the three "manufacturers" is less clear-cut. Under both sets of calculations Singapore enjoys a significant terms of trade improvement. However, the results for Hong Kong and the Republic of Korea differ markedly between the two sets of calculations. When the Japanese price estimates are used, Hong Kong's position is the same as that of India while the Republic of Korea enjoys a significant terms of trade improvement but, when the United States price estimates are used, both suffer a terms of trade deterioration of similar magnitude to those suffered by the primary producing countries.

The important difference between the two sets of estimates of price effects of pollution control costs lies in the size, rather than the direction, of the relative price impacts estimated. If the moderate relative price effects reported for the United States were representative of developed country environmental policy generally, our results suggest that the terms of trade effects on developing countries would also be small and, in most cases but particularly for primary producing countries, negative. On the other hand, if the relative price effects of developed country environmental policy were more substantial, this would lead both to more marked terms of trade effects on developing countries and to more clearly defined differences between the impacts on different sorts of countries. In particular, the possibility exists that countries with a specialization in manufactured goods, but without a heavy emphasis on labour-intensive manufactures, might enjoy significant terms of trade improvements.

It should be noted, however, that a country which has a relatively strong concentration of activities for which developed country pollution control costs are relatively high is liable itself to suffer environmental problems. The extent to which an apparently favourable terms of trade

impact is offset by pollution control costs in the developing country concerned will be important in determining the welfare gain to that country.[51/]

The terms of trade effects estimated above suggest the likely direction of the immediate impacts on developing countries of developed country environmental policy, but are not a sufficient indicator of the magnitude of those effects. That depends, also, on the nature of the resource reallocations which take place in response to the terms of trade changes. Indeed, where activities which did not previously enter a developing country's trade become established in that country, assessment of terms of trade effects based on original trade structures may not even provide a reliable guide to the direction of the welfare effects.

Our analysis of relative pollution control costs has suggested that the greatest competitive advantage to developing countries is likely to lie in the processing of basic raw materials. However, pollution control costs are only one of a number of factors which influence the location of different activities. On the one hand, it may be that other factors continue to favour location of processing activities in developed countries despite the high pollution control costs incurred in those countries. On the other hand, changes in relative competitiveness resulting from other causes may swamp the effects of pollution control costs, and the direction of industry relocation may be quite different from that which would be suggested by environmental considerations alone.

In the last Part of this study we examine the pattern of regional trade and investment in selected raw-materials-based activities and the forces leading to change in that pattern, attempting to place the effects of developed country environmental policy in perspective alongside other factors.

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51/ This point is discussed further on page 57.

V. TRADE AND INVESTMENT IN RAW-MATERIALS-BASED INDUSTRIES AND THE EFFECTS OF ENVIRONMENTAL CONTROLS

The raw-materials-based industries discussed in this Part are minerals and metals, with particular reference to iron and steel and aluminium, and pulp and paper, all industries for which pollution control cost estimates are relatively high.

The pattern of trade and investment in these activities in the ESCAP region is dominated by Japan's heavy requirements for raw-materials-based products. Characteristically, Japan has not imported processed products but has established domestic processing facilities based on large-scale imports of basic raw materials. One area of interest, then, is the possibility that high pollution control costs for processing in Japan might influence that structure of trade, leading to a larger proportion of processed products being imported into Japan.

The major producer of many raw materials in the region is also a developed country, so that a second area of interest is the possibility that environmental controls over raw materials production in Australia might confer some competitive advantage on developing country producers, or potential producers, of these products.

Other things being equal, it might be expected that relocation of processing facilities outside Japan would be directed towards areas where basic raw materials were produced, in order to take advantage of economies associated with the integration of raw materials production and processing and the minimization of transport and transactions costs. For many products, these factors might favour the location of new processing facilities in Australia, rather than in developing countries of the region. Thus, the extent of pollution control costs for processing in Australia might also be important in influencing the pattern of trade and investment in raw-materials-based products.

An important factor tending to favour location of processing activities in developed countries is the more ready availability of capital and technical expertise. However, disadvantages suffered by developing countries in these areas can, to a large extent, be overcome by direct foreign investment. In the case of processing facilities designed principally to supply the Japanese market, ownership ties with Japanese purchaser companies or trading

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houses may be of crucial importance in gaining market access.[52] For a number of institutional reasons, and particularly because of the more ready availability of concessional loan finance for Japanese companies investing in developing countries, there is likely to be a bias towards locating "offshore" processing facilities in developing countries.

Trade and investment in iron and steel

The principal raw materials employed in steel production are iron ore and coking coal. Within the region, Australia, China, India and the Democratic People's Republic of Korea provide 97 per cent of iron ore production and, between them, account for 25 per cent of total world production. China's iron ore production is all used domestically, while the Democratic People's Republic of Korea exports about 1.5 million tons to China each year and uses the remaining production in its domestic iron and steel industry. The only substantial exporters of iron ore are Australia (81 million tons in 1977) and India (22 million tons in 1977). Approximately 77 per cent of Australia's iron ore exports and 81 per cent of India's exports were purchased by the Japanese steel industry, accounting for over 60 per cent of Japan's total iron ore supply with imports from Brazil accounting for a further 20 per cent.

Although there are small iron ore deposits in other countries in the region, and iron sand is mined in a number of areas,[53] the bulk of the region's supplies of iron ore will continue to come from Australia and India, with Brazil the main outside competitor. The relative competitiveness of these suppliers is unlikely to be affected significantly by differential environmental control costs in mining, since the bulk of Australia's iron ore production comes from a relatively remote area.

/Australia

52/ While Japanese processors have historically relied heavily on long-term contracts with independent suppliers to provide security of supply of primary raw materials, direct overseas investment is much more likely to be an important factor in the trade in processed products. See Ben Smith, "The Japanese connection" in P. Hastings and A. Farran (eds), Australia's Resources Future (Melbourne, Thomas Nelson, 1978).

53/ Most notably in New Zealand. Iron sand mining in the Philippines has been terminated as a result of environmental difficulties.

Australia is the only significant exporter of coking coal in the region, providing about 40 per cent of the coking coal input into the Japanese steel industry and also exporting to most other steel producers in the region. The main competition for Australian coal comes from United States' and Canadian suppliers. Although environmental controls over the mining and shipping of coking coal in Australia would be more important than for iron ore, their impact would probably be similar to controls imposed in North America and would not much affect the relative competitiveness of the alternative suppliers. Equally, a rise in coking coal prices, due to environmental policies in the developed countries supplying ESCAP region steel producers, would not have much effect on the competitiveness of regional steel production, since steel producers internationally are heavily dependent on developed country sources of coking coal. It is possible that environmental controls in developed countries, and particularly in Australia, might stimulate more rapid exploitation of coking coal resources in India and China and a move towards greater self-sufficiency in coking coal supplies for the expanding steel industries of those countries but, while the extent of such an effect is impossible to quantify, it would certainly be relatively minor.

Steel production in the ESCAP region accounts for about 22 per cent of world output and has declined in line with world production during the recession. However, Japan's steel production has declined more sharply than that of the region as a whole, so that its share of regional output fell from 72 per cent in 1974 to 68 per cent in 1977. This decline in Japan's share is matched almost exactly by the increase in the share of the Republic of Korea, neither of which produced steel in 1974.

It now seems clear that, although the Japanese steel industry can expect to move closer to full capacity as the recession abates, future growth in Japan's steel production will be extremely limited. The reduced competitiveness of the Japanese steel industry has a number of causes, including a general shift in Japan's comparative advantage away from physical-capital-intensive, heavy industry towards technology-based activities, but high pollution control costs have been a significant contributory factor. The strong export orientation of the Japanese industry, for which exports

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have represented up to 40 per cent of total sales, has left it exposed to the full impact on competitiveness of adverse cost movements.54/

The decline in Japan's competitiveness in steel production has been matched by increased competitiveness in a number of developing countries in Asia and South America. The most notable example is the Republic of Korea which, although still only a small steel producer, has successfully built up an industry which exports over one third of its output. While high pollution control costs in Japan have, and will, increase the competitiveness of developing country producers in international markets, it should be stressed that these developments are more fundamentally the result of broader changes in the pattern of comparative advantage and would have occurred anyway. Thus, developed country pollution control costs can be seen as an additional force which is complementary to the operation of more powerful forces for change in the location of world steel production.

The impact of pollution control costs on the Japanese steel industry does not especially favour developing countries in the ESCAP region (by comparison, for example, with Brazil) since the regional orientation of the steel trade is not particularly strong. However, attempts by the Japanese steel industry to reduce its pollution control costs by relocating production of intermediate products offshore are likely to have direct regional implications, since costs of transportation of those products to Japan will be an important factor.

Pollution control costs are particularly high for the operation of coke ovens, blast furnaces and sinter plants, so that relocation of these activities outside Japan and a shift in the structure of the domestic industry towards the final stages of steel making could significantly reduce pollution control loadings. On the other hand, the very precise blending techniques which have contributed to the efficiency of Japanese steel production, and which rely heavily on co-ordinated, large-scale purchases of raw materials from a range of sources, would be more difficult to maintain if coke ovens and blast furnaces were dispersed geographically. Nevertheless,

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54/ In this sense, the Japanese steel industry is more vulnerable than those of other developed countries which protect their domestic industries from "excessive" import penetration. As the major world exporter of steel, Japan will bear the brunt of increased competitiveness of developing country producers.

a long-term possibility is that the Japanese steel industry may become a substantial importer of pig iron supplied by iron and steel producers in developing countries of the region.

To date, the major example of any relocation of intermediate production has been the establishment of a sinter plant in the Philippines by Kawasaki Steel. This plant uses Australian and Brazilian fine iron ores and coke breeze imported from Japan. It seems clear that this overseas investment was the result of environmental pressures, and that the pollution control procedures adopted at the plant are substantially less rigorous than those which would be required in Japan.[55/]

While further relocation of sinter plants would offer considerable scope for reducing pollution control costs, this will be inhibited for some time to come by the present over-capacity of relatively new sinter plant in Japan. Also, the alternative possibility is that the Japanese steel industry will substitute pelletized find ores for sintered ores.[56/] Whereas offshore sinter plants would be expected to be located in developing countries close to Japan, pelletizing plants are established in conjunction with iron ore mines. Although recent pellet plants designed to supply the Japanese steel industry have been located in Brazil, Chile and India, rather than in Australia, this reflects principally the low grade of the fine ores from these sources which cannot economically be used without pelletizing, and it is unlikely that pollution control costs in Australian production of pelletized ores would have other than a marginal effect on such location decisions.

In general developed country environmental control costs relating to iron and steel minerals and products appear unlikely to have substantial effects on the trade of ESCAP developing countries. The only areas where pollution control costs may have a major influence on changes in the pattern of trade and investment will be in the relocation of intermediate production outside Japan, and the probable beneficiaries from this are likely to be the Philippines and Indonesia. It may be, however, that the establishment of such facilities will itself contribute to the possibility of those countries developing their own steel industries. The current

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55/ B.I. Castleman, op. cit., p. 25.

56/ To date, the Japanese industry has been relatively slow to adopt the use of iron ore pellets, by comparison with U.S. and European producers, in part because sintering provides a use for coke breeze which would, otherwise, be a waste product from coke production. Although pelletizing is relatively energy intensive, advantages in using pellets allow them to command a premium.

consideration of an integrated steelworks on Mindanao in the Philippines is related to the existence of the Kawasaki sinter plant, since economies may be effected in the shipping and handling of raw materials by joint arrangements between the steel mill and sinter plant. In that case, then, Japan's high pollution control costs for steel making may directly contribute to decisions about the location of steel-making facilities in developing countries. Otherwise, they provide a general encouragement to expanded production in developing countries whose comparative advantage is basically determined by other factors.

Trade and investment in bauxite/alumina/aluminium

The production of aluminium involves three distinct processes: mining of bauxite, refining of alumina, and reduction of alumina to aluminium by a highly energy intensive smelting process.

Within the ESCAP region, India, Indonesia and Malaysia produce significant quantities of bauxite but Australian production accounts for 90 per cent of the region's output (excluding China which has substantial production the exact size of which is unknown) and over one third of total western world supplies. While India uses most of its bauxite production domestically to produce aluminium, Indonesia and Malaysia have in the past exported their production to Japan. Australia has also exported bauxite to Japan and to Europe, but the bulk of Australia's production is exported as alumina to a number of countries and chiefly to the United States.

The ESCAP region produced 14 per cent of world aluminium output in 1977, a one per cent increase over its share in 1974. Almost 60 per cent of the region's output was produced in Japan, with a further 19 per cent being produced in Australia and New Zealand. India and China each produced about 9 per cent of the region's output, and the Republic of Korea around 1 per cent each. While India is close to self-sufficient in aluminium production, Japan and China both import almost 50 per cent of their requirements and the Republic of Korea are even more heavily dependent on imports. Only Australia and New Zealand are net exporters of aluminium, and supplies from these countries presently meet only a small part of the region's total import requirements.

The Japanese aluminium industry obtains about 70 per cent of its raw material inputs as bauxite and 30 per cent as alumina. All of the alumina imports and about 60 per cent of the bauxite imports come from Australia, while imports of bauxite from Indonesia and Malaysia make up

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the bulk of the remaining supplies.

Alumina refining has quite substantial environmental problems in Japan associated with the need to dispose of large volumes of alkaline "red mud".[57/] Also, this activity is relatively energy intensive, requiring considerable amounts of fossil fuels for steam generation, and Japanese energy prices are high. For both of these reasons, there would seem to be a strong incentive to relocate alumina refining outside Japan. However, a more powerful force is the lack of competitiveness of aluminium smelting in Japan, which is likely to lead to a relocation of the whole industry.

While direct pollution control costs no doubt contribute to the problems faced by the aluminium smelting industry in Japan, the major factor is the high costs of electric power in that country. This is due both to the reliance on imported fuels, and especially oil, and to high pollution control costs in thermal power generation.[58/] Shishido and Oshizaka estimate that the impact of the oil price rise on the cost of electricity may be only slightly greater than that of pollution control costs, but this is almost certainly an underestimate.[59/] In any event, power costs in Japan were high before pollution control costs and the oil price increases became important and aluminium smelting has never been more than marginally economic.

Relocation of aluminium smelting outside Japan will depend chiefly on costs of electricity supply in alternative locations. An early example was the development by Japanese and Australian companies of the Bluff smelter in New Zealand. This smelter uses hydro-electric power to smelt Australian alumina, with the aluminium produced being exported to Japan. More recently, Japanese aluminium companies have become involved in projects based on hydro-power in Indonesia and Brazil.

/ Production

57/ The volume of "red mud" which needs to be disposed of is approximately half the volume of bauxite processed.

58/ The Japanese aluminium smelting industry relies on oil-fired power for almost two thirds of its electricity needs, compared to an average of about 12.5 per cent for the western world as a whole and only 1 per cent for the United States.

59/ They have estimated the effect of the oil price rise on electricity prices in Japan as approximately 13 per cent, compared to approximately 11 per cent for pollution control costs: Shishido and Oshizaka, op. cit., p. 24.

Production of aluminium in the region outside Japan will be stimulated not only by the reduced competitiveness of the Japanese industry but also by the increasing requirements of the more rapidly growing developing countries, none of which has the capacity to generate electricity at low costs.[60/] This will benefit India, which has considerable untapped bauxite reserves and plans to expand aluminium production substantially, but it is doubtful whether Indian producers can compete with countries where hydro-electric power is available. Moreover, Australia's coal-fired power generation is relatively low cost, because location of power stations on coalfields away from urban areas reduces both transport costs and pollution control costs, so that developing countries will face strong competition from Australian suppliers of aluminium.[61/]

While pollution control costs have obviously been important in reducing the competitiveness of the Japanese aluminium industry, it seems unlikely that those costs in Australia are sufficient to offset the substantial energy costs advantage that Australia has over most developing countries in the region. This applies, to a lesser extent, also to alumina refining where the relative availability of space allows large "mud ponds" to be set aside in Australia for waste disposal.[62/]

It should be noted that, in contrast to the trade in bauxite which has had a strong regional orientation, transport costs are a relatively minor factor in the aluminium trade. Thus, not only will ESCAP developing countries seeking to develop aluminium smelting capacity, based either on

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60/ Proposals for expansion of aluminium smelting capacity in the Republic of Korea, for example, have so far failed to gain government approval because of high energy costs.

61/ Apart from the aluminium smelting plant to be developed in Queensland by Comalco in association with Japanese interests, there is a number of plans for new smelters based on coal-fired power in New South Wales.

62/ This depends on location, however, and difficulties in disposing of wastes have been cited as contributing to problems faced by Comalco in establishing a second alumina refinery in Queensland. At one stage it was proposed to locate this refinery in the Philippines, but in the end, the project was shelved.

indigenous bauxite reserves or on alumina imported from Australia, need to compete with Australian producers but they will also face strong competition from countries with relatively cheap power supplies outside the region.

Over-all, it seems likely that, as with iron and steel, pollution control costs are a secondary factor influencing location decisions in the aluminium industry. Although Australia's costs due to environmental controls may be higher than those of other countries in the region, they are not so high as to offset other locational advantages that Australia has. Equally, although pollution control costs in the Republic of Korea may be quite low, this is more than offset by the lack of cheap power generation and it would not seem sensible for these countries to seek to develop large scale aluminium industries. Indonesia has the advantage of substantial hydro-electric power potential, as well as relatively low environmental costs, and these will lead to the steady development of aluminium smelting and alumina refining from Indonesia's domestic bauxite resources and, possibly, to smelting of additional alumina imported from other sources.63/

Trade and investment in paper and pulp

As table 9 shows, over 70 per cent of the production of paper and board in the region takes place in the three developed countries, while China accounts for a further 20 per cent. Four developing countries account for most of the remaining production. Only New Zealand exports a significant proportion of its output, although Japan's net exports are, in absolute quantity, twice as great as those of New Zealand. These exports go mainly to other countries in the region, and the region as a whole depends on imports from the rest of the world for about 7 per cent of its total paper consumption.

The pattern of regional production of pulp is similar to that of paper and board, with the developed countries and China accounting for over 90 per cent of output. However, only New Zealand is a net exporter of pulp, selling mainly to Australia and Japan, and the other three countries have a significant dependence on imports. Of the remaining ESCAP countries

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63/ In the initial stages, development of alumina refining in Indonesia will not be sufficiently advanced to meet the needs of the Asahan smelter and it is expected that alumina will be purchased from Australian sources in the meantime.

only two, India and the Philippines, are significant pulp producers and only India approaches self-sufficiency.[64/] The region as a whole depends on imports of pulp from the rest of the world for about 11 per cent of its supplies, with the bulk of these imports coming from North America.

With the exception of Japan, all of the region's pulp producers rely on indigenous raw materials. Table 10 indicates the sources of supply of pulpwood and woodchips to the Japanese pulp industry in 1973, when 35 per cent of requirements were imported. This figure had risen to 43 per cent by 1977. It can be seen that the major source of imports is North America and that, within the region, Australia's share of Japan's imports is more than double that of the developing countries.

The strong dependence on North American supplies of pulp and woodchips is due to the relative absence of coniferous timber in the ESCAP countries and the technological requirement to maintain a substantial proportion of long-fibred pulp, produced from softwoods, in paper making processes. This is reflected also in New Zealand's export specialization in woodchips, pulp and paper, all of which is based on coniferous forest resources.

Japanese overseas investments in activities providing materials for the paper industry are divided between North and South America and southeast Asia and Oceania. As at April 1977, Japanese companies had investments in three pulp making facilities in Canada, two in the United States and one in Brazil. The large new Brazilian plant is supplied with pulpwood from a major forestry development in which there is also Japanese equity, and one of the pulp mills in the United States is associated with a Japanese investment in pulpwood production.

In contrast to the pattern for North and South America, Japanese paper industry investments in Asia and Oceania have been concentrated heavily on production of primary wood raw materials, with the only exception to this being one pulp mill in New Zealand. Malaysia has been the major recipient of Japanese investment in pulpwood/woodchip production, with five separate facilities, while Indonesia has two facilities and Papua New Guinea, Australia and New Zealand one each.

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64/ About 70 per cent of India's pulp production is based on non-wood fibres, including bamboo, reeds, and straw.

The main direct competition for developing country suppliers of pulpwood and woodchips comes from Australia, since Japanese imports of wood raw materials from other developed countries are predominantly coniferous. Australia's export woodchip industry has been the subject of a number of environmental enquiries, but the major concern in drawing up regulations controlling the industry has been the maintenance of the value of the basic forest resource rather than strictly external environmental impacts.[65/] To the extent that these are purely economic considerations, which may be only poorly reflected in the actions of private companies due to the methods of licensing and contracting adopted, there is little reason to suppose that controls imposed in Australia are more costly than those which it would be rational for developing country competitors to adopt. However, the desire to maintain forest resources and associated flora and fauna in Australia more than reflects the future economic value of those resources because of the value attached to the preservation of relatively scarce natural environment for its own sake. This, coupled with environmental controls on the operation of woodchipping mills, may provide some competitive advantage to developing country exporters of woodchips. Although there is little evidence which can be brought to bear on the question, it is probable that the competitive advantage to countries such as Malaysia or Indonesia deriving from Australian environmental policy relating to production of woodchips is not great.

The position of developing country exporters of wood raw materials may also be affected by environmental controls in developed countries relating to pulp and paper making. First, it might be thought that pollution control costs could, through their effects on prices, reduce demand for paper and, consequently, for the raw materials used in paper production. However, this effect is not likely to be at all large because paper has no effective substitutes in many uses and, in the packaging area, the substitutes which may be employed are principally plastics whose pollution control costs are also relatively high.

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65/ See for example, Economic and Environmental Aspects of the Export Hardwood Woodchip Industry, Australian Government Publishing Service, Canberra, 1975.

A more substantial possibility is that the relatively high pollution control costs in the manufacture of wood pulp could lead to a substitution away from use of this intermediate input and to greater use of recycled waste paper. In Australia, where around 50 per cent of the material input into the production of packaging papers is waste paper, it has been estimated that replacing this with additional inputs of wood pulp would add 60-75 per cent to the pollution control cost loading borne by the final product.[66/] In Japan, waste paper now provides about 40 per cent of the total material input into paper production, compared to about 25 per cent for the Australian industry over-all and between 20-30 per cent for most major paper producing nations. While there are evident environmental advantages to the high Japanese use of recycled waste paper, the extent to which this has been stimulated by environmental considerations is not clear. Uncertainties relating to the growing dependence on imported wood raw materials, and fears of future scarcity of such materials have also played a significant role. Nevertheless, it seems likely that pollution control costs have played some part in decisions to facilitate increased recycling of waste paper and that this would have impacted adversely on suppliers of primary wood raw materials in general. The extent to which any further movement in this direction can take place is heavily constrained by logistical problems in obtaining larger quantities of waste paper as well as by technical factors in the manufacture of paper. Thus, further substitution away from pulp based on primary wood raw materials is perhaps unlikely.

On balance, the position of developing countries such as Indonesia, Malaysia and Papua New Guinea, which export wood raw materials for paper making to Japan, has probably not been affected significantly by developed country environmental policy, with favourable and unfavourable effects tending to offset one another.

As indicated earlier, pollution control costs are relatively high in the production of wood pulp, so that one possibility is that there might be some relocation of the pulp-making activity towards developing countries where control costs were lower. The substantial economies associated with integration of intermediate production with either

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66/ Department of Environment, Housing and Community Development, Pollution Abatement Costs in the Pulp and Paper Industry, Canberra, A.G.P.S., 1977.

production of the raw material or production of the final product suggest that any relocation of pulp manufacture not integrated with paper making is likely to be directed towards areas where primary wood raw materials are produced. Within the ESCAP region, this is likely to mean further processing of pulpwood prior to export in Australia or in developing countries such as Indonesia, Malaysia or Papua New Guinea.

Pollution control costs differ between the alternative processes for manufacturing wood pulp. Between the two classes of chemical pulping, OECD estimates suggest that pollution control costs for sulphite pulp are more than twice those for sulphate pulp.[67/] In Japan, pollution control costs in 1975 were estimated to be 12.9 per cent of product price for sulphite pulp and only 3.8 per cent for sulphate pulp. In recent years there has been a considerable movement away from the use of sulphite pulp and this is expected to continue. For the other broad classes of pulps, semi-chemical and chemi-mechanical, pollution control costs were estimated by the OECD to average 9.6 per cent of product price in 1975, with the figure for Japan being slightly higher. However, the economies associated with the integration of semi-chemical pulp production and the manufacture of corrugated board, coupled with the low unit value of these pulps, have tended to mean that they are rarely traded internationally.

The possibilities of substituting away from the use of pulps with high pollution control costs, and the resistances to trade in some forms of pulp, significantly reduce the incentive to relocate pulp manufacture in countries where pollution control costs are lower. However, it seems probable that environmental policy in Japan will contribute to moving Japanese paper producers towards a greater dependence on imported pulps.

In evaluating the relative competitive positions of Australia and developing countries in the region, a number of issues, most of which are also important in relation to processing of other raw materials, require consideration. It appears that Australia's pollution control costs for pulp and paper are smaller than those of Japan.[68/] Although developing countries may have smaller pollution control costs than Australia, Australia's technological advantage deriving from its

/established

67/ Pollution by the Pulp and Paper Industry (OECD, 1973).

68/ The evidence on this is not clear, but this would seem to be implied by the limited data available.

established pulp and paper industry, and the more ready availability of capital for what is a relatively capital intensive industry, may more than offset the advantage that pollution control costs alone confer on the developing countries. On the other hand, as we have noted earlier, overseas investment by Japanese companies may be capable of compensating for these disadvantages of developing countries and such investment decisions are likely to be biased in favour of locating in developing countries.

Over-all, any relocation of wood pulp production in the region, based on exports to the Japanese market, would probably involve developments in Australia as well as in countries such as Indonesia, Malaysia and Papua New Guinea, with the developing countries possibly having a larger share of pulp supply to Japan than they currently have of wood raw materials. However, such developments within the region must also compete with possible developments elsewhere in the world. To date, in fact, the only Japanese investment in wood pulp production in a developing country has been in Brazil, where hardwood chips are converted to pulp before export to Japan.

Although pollution control costs in the manufacture of paper and board are absolutely smaller than those incurred in production of wood pulp, as a proportion of value added they are relatively substantial. Where paper is manufactured wholly from pulp, value added is generally only 10-20 per cent of the value of output, so that pollution control costs amounting to only 2 per cent of product price may represent as much as 20 per cent of value added.[69/] The significance of this is that what appear to be small differences in pollution control costs between countries may have a substantial impact on the profitability of investments in paper making.

One possible implication of this is that developing countries where capital and technology are relatively available, but where pollution control costs are relatively low, may be capable of competing internationally in the production of paper. Among the ESCAP developing countries, the most likely country to fulfill this role is the Republic of Korea, which is already a small net exporter of paper produced largely from imported pulp. One constraint on such a development, however, is the availability

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69/ Value added is greater when waste paper is used in the production process, since preparation of the waste paper is counted as part of the paper-making activity.

of waste paper as an input which allows substantial economies to be reaped in developed countries. Given that the Republic of Korea's *per capita* consumption of paper is only about one eighth of that of Japan, the possibilities of recycling waste paper to meet the needs of a large scale paper export industry are likely to be severely limited.

While it appears that some developing countries in the region could benefit from developed country environmental policies relating to the pulp and paper industry, as a result of increased processing of wood raw materials or due to the development of an export paper industry, it does not seem likely that such developments will be very substantial or widespread.

Other raw-materials-based products

The situation of aluminium, where the main force for relocation is low energy costs, closely parallels that of other basic metals for which energy intensive smelting and refining processes are employed. The recent major nickel development based on hydro-electric power at Sulawesi in Indonesia, in which there is Japanese equity and which will provide nickel matte to Japanese refineries, is an important example. However, for some metal industries pollution control costs are substantially greater than is the case for either iron and steel or aluminium, because of dangerous substances associated with the ores being processed or because the metals themselves are hazards to health.

In the smelting of copper, high levels of arsenic sometimes have to be recovered as by-products. Copper concentrates from the Philippines have a high arsenic content and environmental controls over arsenic production in the United States are making it increasingly difficult to process concentrates from this source. Extension of such controls in developed countries will reduce demand for copper raw materials from the Philippines, and will stimulate that country to extend its own refining activities.[70/]

Some activities have virtually prohibitive environmental controls imposed in developed countries and these are strong candidates for relocation in developing countries where controls are less severe. In

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70/ Environmental problems have been encountered in the Philippines in relation to copper refining, and delays have recently been imposed on one new development while revised control procedures were drawn up.

recent years Japanese companies have closed down mercury and chromium operations and relocated them in Thailand and the Republic of Korea, and it is probable that a number of similar examples exist.

While controls of pollutants which are harmful only in large volume, such as sulphur dioxide, do provide an incentive for relocation outside Japan, control costs in Australia are substantially lower so that there is no obvious presumption that developing countries in the ESCAP region will be the major beneficiaries of any relocation. However, for industries where the pollutants involved are harmful at quite low concentrations, Australian pollution control costs are much closer to those of Japan and the incentive to relocate in developing countries may be very large.

The principal relocation of processing activities towards ESCAP developing countries resulting from developed country environmental policy, seems less likely to take the form of a general shift in comparative advantage but, rather, to be concentrated on a few activities whose potential for creating environmental damage is very great. This raises important policy issues for the developing countries concerned, and these are commented upon further in the concluding part of the study.

VI CONCLUSIONS AND POLICY IMPLICATIONS

This study has reviewed the nature of the possible effects of developed country environmental policy on developing country trade, examining general resource allocation and macroeconomic effects, effects of developed country product standards, and effects of pollution controls on production processes. The main conclusions are presented below in summary form.

The available evidence suggests that the general resource allocation and macroeconomic effects of developed country environmental policy are not so large as to have any significant impact on developing countries. Broadly, "economic growth" in the developed world will not be retarded to an extent which adversely affects the growth of markets for developing country products.

The imposition of product standards by developed countries is likely to have adverse effects on all developing countries, but particularly

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on those which depend strongly on agricultural/foodstuff exports and which rely on imports of manufactures. These countries are most likely to face difficulties in meeting developed country product standards for their exports and to suffer from the "imposition" of inappropriate product standards incorporated in their imports.

Part of the problem for developing countries lies in difficulties in obtaining information about developed country product standards and in the lack of harmonization between developed countries in the standards set. However, although it would clearly be in the interest of developing countries to press for more satisfactory advance notification of standards, it is not certain that greater harmonization of developed country policies would be advantageous, since this could lead to more stringent standards being set on average. Neither is it obvious that harmonization of standards and procedures for policing them would reduce the extent to which they were used as covert trade restrictions by developed countries.

In general it appears that the costs of pollution controls relating to production processes in developed countries are borne by the industries concerned, so that they are likely to be fairly fully reflected in price changes. While this would be expected to increase developing country competitiveness in production of goods whose pollution control costs were relatively high in developed countries, when account is taken of the exchange rate/inflationary adjustments needed to offset the balance of payments impact developing country competitiveness would be expected to decline for activities where developed country pollution control costs were relatively low.

A first estimate of the welfare effects on developing countries of the relative price changes due to developed country environmental controls can be obtained by examining effects on the terms of trade. Using United States and Japanese estimates of price effects of pollution controls, the terms of trade impact on eleven ESCAP developing countries was estimated. It was found that the terms of trade deteriorate for those countries most heavily specialized in primary production, Fiji, Indonesia, Papua New Guinea, Thailand and the Philippines, though the extent of that deterioration is relatively small when United States price estimates are employed. For two other primary producing countries, Malaysia and Sri Lanka, the

/terms

terms of trade is little affected if rubber exports are treated as closely substitutable for synthetics. Hong Kong and India suffer small terms of trade deteriorations, and only the Republic of Korea and Singapore appear to benefit from significant terms of trade improvements. In the case of the Republic of Korea, this result only arises when the greater relative price effects estimated for Japan are used. Using the United States price estimated, the Republic of Korea suffers a terms of trade deterioration.

The welfare loss from a terms of trade deterioration will be smaller the greater is the extent to which resources are encouraged to move between activities by the relative price changes. Having observed that pollution control costs for raw materials processing activities are relatively great, we considered the likely influence of such costs on the pattern of trade and investment in selected raw materials processing industries. While there is some indication that pollution control costs may contribute to a relocation of processing activities in developing countries of the region, this influence is, in general, either limited or overshadowed by other factors. It appears unlikely that the impact on economic welfare of adverse terms of trade movements due to the price effects of pollution control costs will be reduced substantially by a major movement of processing activities into primary producing developing countries.

While the above suggests that the influence of developed country environmental policies on developing countries in the region is likely to be adverse, particularly for those countries most heavily specialized in primary products, it should be stressed that the size of those effects is relatively small. By comparison with the major shifts in comparative advantage occurring in the region, which result mainly from rapidly increasing labour and energy costs in Japan and from a take-off into sustained growth by some of the developing countries, the general influence of environmental controls on patterns of trade and investment is not very important.

However, our generally aggregative approach and the absence of adequate date at the industry subsector level do not allow accurate judgements to be made about the extent of relocation of processes which are of relatively minor economic value individually but whose pollution control costs are extremely high. While it would be inappropriate to suggest that

/developing

developing countries should adopt the same standards as developed countries for these hazardous activities, there is a substantial danger that lack of information on the part of developing country administrations may lead them to accept levels of control which do not reflect the costs of the damage generated. The provision of information on risks associated with the more hazardous production processes, and on the costs and effectiveness of various alternative control procedures, would be of substantial assistance to developing country governments in establishing policies appropriate to their own particular circumstances towards such activities. This should, perhaps be a priority for technical and economic research at the international level.

More generally it will rarely be the case that costs of environmental damage from polluting activities are, as we have earlier assumed for analytical convenience, zero in ESCAP developing countries. This means that our assessment of the terms of trade effects on developing countries of developed country environmental policy tends to overstate the gains, since we have assumed that developed country exporters can obtain price increases equivalent to those for competing developed country products without needing to devote resources to pollution abatement in their own production processes.

As the concentration of polluting activities in ESCAP developing countries increases, whether those industries were initially attracted there by low pollution control costs or by other factors, so will the social costs of environmental damage increase. Thus, the pursuit of relatively low levels of environmental controls will become progressively less desirable if community well-being is to be maximized. Essentially, industrial development involving increasing pollution will reduce the availability of environmental amenity relative to material goods and increase the relative value of environmental protection. Over time, then, it will be necessary for developing country governments to adopt more and more stringent environmental controls, and these will steadily erode any competitive advantage that they may presently obtain from relatively low pollution control costs.

/While

While recognizing the limits outlined in the preceding paragraph, and the need for developing country governments to ensure that they have adequate information on the environmental effects of different activities, it should be stressed that in many areas it remains sensible for developing countries to set standards which are less stringent than those imposed in developed countries. The important policy issue for developing countries is to set levels of environmental control (and this may be defined to include such things as workplace regulations and labour market restrictions, as well as pollution controls) which are appropriate to their own circumstances, and to resist pressures for them to adopt levels of control which are appropriate to countries at a substantially higher level of material well-being.

/Table 1.

Table 1. Total expenditures allocated to pollution control as a proportion of GNP

	Percentage of GNP	
	1971-1975	1976-1980
Federal Republic of Germany	0.8	1.7
Italy	0.5	1.3
Japan[a/]	3.0 - 5.5	n.a.
Netherlands	0.4	1.3
Sweden[a/]	0.5 - 0.9	n.a.
United States	0.8	1.7

Source: Organization for Economic Co-operation and Development, Economic Implications of Pollution Control, February 1974.

Note: a/ Higher figure allowing for operating costs on the basis of the relationship between investment and operating costs in other countries.

/Table 2.

Table 2. Pollution control investment as a proportion of total investment, by industry: United States of America, 1973-1977

	Pollution control as percentage of total investment in plant and equipment				
	1973	1974	1975	1976	1977 a/
All industry	4.9	5.0	5.8	5.6	5.6
Manufacturing	8.3	8.0	9.3	8.3	7.9
Iron and steel	16.3	12.1	13.5	15.1	19.1
Non-ferrous metals	31.1	21.8	24.1	18.9	17.1
Electrical machinery	4.5	6.8	5.8	5.6	4.1
Other machinery	2.3	1.8	1.8	1.6	2.4
Motor vehicles	6.4	4.1	3.9	3.6	4.3
Aircraft	3.8	2.9	2.8	3.3	2.8
Stone, clay, glass	9.6	12.9	14.3	6.1	6.7
Other durables	4.9	4.5	5.3	3.9	3.9
Food and beverages	5.0	4.7	5.2	4.5	4.9
Textiles	3.7	3.3	4.6	4.4	3.8
Paper	18.8	19.3	16.8	14.7	14.1
Chemicals	9.6	8.3	10.9	11.4	10.2
Petroleum	10.3	10.1	11.8	10.9	9.5
Rubber	3.1	3.2	4.0	3.4	2.7
Other non-durables	1.2	1.8	2.8	1.4	1.8
Mining	3.3	1.8	1.9	2.2	2.9
Transportation	0.7	1.5	1.2	1.1	1.2
Utilities					
Electric	8.7	8.9	9.7	10.5	10.9
Other	1.5	1.5	1.5	1.2	0.8
Commercial etc.	0.6	0.6	0.6	0.5	0.5

Source: Council on Environmental Quality, Eighth Annual Report (Washington, D.C., United States Government Printing Office, 1977).

Note: a/ Planned expenditures.

/Table 3.

Table 3. Pollution control investment as a proportion of total investment, by industry: Japan, 1972-1978

	Pollution control as percentage of total investment in plant and equipment						
	1972	1973	1974	1975	1976	1977[a/]	1978[b/]
All industry	8.3	9.8	13.4	17.1	15.3	8.9	6.3
Iron and steel	10.1	14.9	16.1	17.9	23.4	15.2	13.5
Petroleum	16.8	16.5	25.8	34.4	39.4	21.0	7.4
Thermal power stations	26.0	30.6	47.7	47.4	45.0	35.6	25.9
Paper and pulp	15.9	22.4	24.2	24.6	21.7	10.2	8.2
Non-ferrous metals	12.0	8.6	11.1	15.1	12.3	17.7	14.1
Chemicals (excl. petrochemicals)	9.2	14.7	27.5	32.0	21.3	12.8	7.2
Machinery	3.7	4.2	5.0	5.0	4.1	2.9	2.7
Petrochemicals	9.0	11.9	8.7	22.3	18.4	10.2	8.5
Mining (excl. coal)	18.4	21.2	30.9	36.2	38.3	33.1	23.0
Textiles, yars	5.6	8.6	12.5	18.1	9.2	4.2	3.0
Cement	12.7	10.4	15.5	15.1	15.3	9.6	14.0
City gas	2.1	2.2	3.2	4.1	1.5	1.1	1.2
Coal	3.3	4.1	2.6	8.6	3.4	2.1	2.1
Lumber	6.9	5.8	4.7	9.3	6.3	5.4	3.4
Electric power (excl. thermal power stations)	0.8	1.2	1.0	1.0	0.9	0.8	0.7
Foods	-	-	-	-	-	-	-
Miscellaneous	2.4	7.8	5.9	9.1	4.9	3.7	3.2

Source: Data supplied by Ministry of International Trade and Industry, Japan.

Notes: a/ Preliminary estimates.
b/ Planned expenditures.

/Table 4.

Table 4. Pollution control costs as a proportion of value added and price, by industry: United States of America

	Industry group	Direct costs as percentage of value added a/	Direct costs as percentage of price	Total costs as percentage of value added	Total costs as percentage of price
1.	Livestock and products	4.0	1.28	6.0	1.98
2.	Other agricultural products	3.0	1.92	4.0	2.46
3.	Forestry and fishery products	1.0	0.64	2.0	1.05
5.	Iron and ferro-alloy ores mining	1.0	0.82	2.0	1.16
6.	Non-ferrous metal ores mining	1.0	0.82	2.0	1.29
7.	Coal mining	3.0	1.76	4.0	2.21
8.	Crude petroleum and natural gas	1.0	0.41	1.0	0.64
9.	Stone and clay mining and quarrying	1.0	0.41	2.0	0.95
10.	Chemical and fertilizer mining	1.0	0.82	2.0	1.31
13.	Ordnance and accessories	1.0	0.53	5.0	2.36
14.	Food and kindred products	1.0	0.36	3.0	1.01
15.	Tobacco manufactures	0	0.18	1.0	0.51
16.	Broad and narrow fabrics, yarn, thread	1.0	0.38	3.0	1.02
17.	Misc. textile goods and floor covering	1.0	0.38	4.0	1.10
18.	Apparel	0	0.19	1.0	0.50
19.	Misc. fabricated textile products	1.0	0.19	2.0	0.55
20.	Lumber and wood products, except containers	0	0.10	1.0	0.45
21.	Wooden containers	0	0.05	1.0	0.56
22-23.	Furniture and fixtures	0	0.05	1.0	0.59
24.	Paper and allied products, except containers	4.0	1.63	5.0	2.33
25.	Paperboard containers and boxes	4.0	1.63	6.0	2.50
26.	Printing and publishing	0	0.08	1.0	0.56
27.	Chemicals and selected chemical products	5.0	2.19	8.0	3.25
28.	Plastics and synthetic materials	6.0	2.19	9.0	3.34
29.	Drugs, cleaning, toilet preparations	2.0	1.10	4.0	1.78
30.	Paints and allied products	9.0	3.29	12.0	4.27
31.	Petroleum refining and related products	13.0	3.73	16.0	4.58
32.	Rubber and misc. plastic products	1.0	0.63	3.0	1.38
33.	Leather tanning and industrial leather	3.0	0.95	4.0	1.38
34.	Footwear and other leather products	1.0	0.32	1.0	0.57

/Table 4 (continued)

Table 4 (continued)

Industry group	Direct costs as percentage of value added a/	Direct costs as percentage of price	Total costs as percentage of value added	Total costs as percentage of price
35. Glass and glass products	2.0	0.86	3.0	1.55
36. Stone and clay products	4.0	1.72	5.0	2.40
37. Primary iron and steel	3.0	1.47	5.0	2.16
38. Primary non-ferrous metals	6.0	1.76	8.0	3.09
39. Metal containers	2.0	0.53	4.0	1.35
40. Heating, plumbing, structural metal	1.0	0.53	3.0	1.35
41. Stamping, screw machine products	1.0	0.53	3.0	1.28
42. Other fabricated metal products	1.0	0.53	3.0	1.21
43. Engines and turbines	2.0	1.03	4.0	1.66
44. Farm machinery and equipment	2.0	1.03	4.0	1.66
45. Construction, mining, oil field equipment	3.0	1.03	6.0	1.94
46. Metals handling machinery and equipment	3.0	1.03	5.0	1.75
47. Metal-working machinery and equipment	2.0	1.03	3.0	1.53
48. Special industrial machinery and equipment	3.0	1.03	4.0	1.61
49. General industrial machinery and equipment	2.0	1.03	4.0	1.63
50. Machine shop products	2.0	1.03	3.0	1.58
51. Office computing and accounting machines	1.0	0.49	2.0	0.89
52. Service industry machines	3.0	1.03	5.0	1.63
53. Electric industry equipment	1.0	0.49	2.0	1.07
54. Household appliances	2.0	0.49	5.0	1.22
55. Electric lighting and wiring equipment	1.0	0.49	3.0	1.14
56. Radio, TV communications equipment	1.0	0.49	2.0	0.84
57. Electronic components and accessories	1.0	0.49	3.0	1.04
58. Misc. electrical machinery and supplies	1.0	0.49	2.0	1.11
59. Motor vehicles and equipment	4.0	1.19	7.0	2.04
60. Aircraft and parts	1.0	0.57	2.0	1.06
61. Other transportation equipment	2.0	0.72	3.0	1.31
62. Scientific and controlling instruments	7.0	3.37	9.0	4.03
63. Optical, opthalmic and photographic equipment	5.0	3.37	6.0	3.96
64. Misc. manufacturing	3.0	1.17	4.0	1.67

Notes: a/ Calculated by the authors from relationships between values of the other columns.

Sources: I. Walter, "The Pollution Content of American Trade", Western Economic Journal, Vol. XI, No. 1, 1973.
I. Walter, "Pollution and Protection: U.S. Environmental Controls as Competitive Distortions", Weltwietschaftliches Archiv., 1974.

/Table 5.

Table 5: Pollution control costs as a proportion of price, by industry: Japan

Industry group		Total costs as percentage of price	
		A	B
1.	General crop	0.2	0.3
2.	Industrial crop	0.1	0.1
3.	Livestock for textiles	0	0
4.	Livestock	0.7	1.0
5.	Forestry	0.1	0.1
6.	Fisheries	3.2	6.1
7.	Coal mining	0	0
8.	Iron ores	0	0
9.	Non-ferrous metallic ores	0.3	0.6
10.	Crude petroleum and natural gas	0	0
11.	Other mining	0	0
12.	Meat and dairy products	4.4	5.7
13.	Grain products	-0.4	-0.5
14.	Manufactured sea foods	6.4	9.0
15.	Other food	2.9	3.8
16.	Beverages	3.1	4.2
17.	Tobacco	0.3	0.6
18.	Natural textiles	0.8	1.3
19.	Chemical textiles	2.1	3.9
20.	Other textiles	2.1	3.7
21.	Wearing apparel	3.2	4.8
22.	Wood products	2.3	3.5
23.	Furniture	1.6	2.6
24.	Pulp and paper	7.7	11.6
25.	Printing and publishing	0.4	0.6
26.	Leather products	11.8	13.5
27.	Rubber products	1.4	2.7
28.	Basic chemicals	2.7	5.4
29.	Other chemicals	0.4	0.8
30.	Petroleum products	6.6	8.5
31.	Coal products	0.7	1.5
32.	Ceramics	3.4	7.4
33.	Primary iron	7.6	14.5
34.	Steel products	2.5	4.7
35.	Primary non-ferrous metals	1.4	5.3
36.	Fabricated metals	1.1	2.1
37.	Machinery	0.8	1.5
38.	Electrical machinery	0.4	0.8
39.	Automobiles	5.9	6.6
40.	Other transport equipment	0.5	0.9
41.	Instruments and related products	1.1	2.1
42.	Miscellaneous manufacturing	0.3	0.6

Source: S. Shishido and A. Oshizaka, Econometric analysis of the impacts of pollution control in Japan, paper presented to the International Conference for Environmental Protection, Tokyo, May 1976.

/Table 6.

Table 6. Net exports by product category as a proportion of total trade:[a/] eleven ESCAP countries and areas, 1974

Industry group	Fiji	Hong Kong	India	Indonesia	Malaysia	Papua New Guinea	Philippines	Republic of Korea	Singapore	Sri Lanka	Thailand
1/2 General/industrial crop	72.97	-2.06	28.07	2.82	8.80	25.96	51.98	-7.82	0.62	55.13	21.34
3/4 Livestock	-0.04	-15.49	-0.01	0.24	-0.11	0.07	-0.06	4.89	0.08	0.08	0.39
5. Forestry	0.48	-0.55	0.31	9.85	15.40	2.70	9.07	-4.74	0.66	1.20	1.18
6. Fisheries	-2.82	-1.44	2.43	1.02	0.89	0.93	-0.48	3.86	-0.15	-0.31	2.87
7. Coal mining	-0.11	-	0.15	-0.14	-0.13	-	-0.10	-0.53	-0.01	-0.09	-0.12
8. Iron ores	-	0.52	3.88	-0.14	0.02	0.03	0.27	-3.22	-0.03	-0.03	-1.50
9. Non-ferrous metallic ores	0.13	0.19	0.77	-0.05	-2.11	58.59	15.57	-0.24	0.30	0.28	1.42
10. Crude petroleum and natural gas	-0.14	-0.21	-24.94	62.43	0.65	-0.10	-21.18	-15.03	-19.71	-19.93	-14.82
11. Other mining	-0.21	-0.15	-0.67	-0.50	-0.59	-0.07	-0.61	0.68	-0.08	3.65	0.90
12. Meat and dairy products	-3.15	-1.50	-0.52	-1.01	-1.88	-6.65	-2.78	0.41	-0.93	-1.63	-0.81
13. Grain products	-4.74	-4.41	-13.37	-14.36	-7.63	-7.10	-6.18	-9.48	-1.39	-39.64	34.27
15. Other food	-0.49	-0.20	0.08	-0.10	-0.09	-1.19	-0.19	0.26	0.16	0.59	0.03
16. Beverages	-0.84	-0.91	-0.02	-0.13	-0.33	-0.83	-0.01	0.01	-0.11	-0.05	-0.05
17. Tobacco	-0.07	-0.51	0.06	-0.06	-0.16	0.09	-	-	-0.09	-	-
18/19 Natural/chemical textiles	-4.26	-2.21	16.43	-4.55	-2.49	-1.35	-1.94	5.57	-1.79	-3.03	-0.84
20. Other textiles	-1.38	-0.60	5.38	-0.36	-0.48	-1.79	0.18	1.91	-0.71	-	1.16
21. Wearing apparel	-2.07	35.86	4.38	-0.14	0.18	-3.05	0.84	22.68	1.57	0.17	1.81
22. Wood products	0.53	-0.34	0.28	-0.04	2.40	0.99	2.89	4.71	1.10	-0.32	0.96
23. Furniture	-0.40	0.34	0.06	-0.17	-0.02	-0.50	0.20	0.26	0.03	-	-0.02
24. Pulp and paper	-1.92	-2.41	-1.23	-2.11	-2.69	-2.24	-2.95	-1.54	-0.88	-1.83	-2.57
25. Printing and publishing	-0.47	0.67	-0.10	-0.15	-0.41	-0.64	-0.34	-0.05	0.15	-0.16	0.81
26. Leather products	-0.77	0.30	5.96	-0.04	0.12	-0.54	0.10	3.99	0.01	0.29	0.11
27. Rubber products	-1.80	2.33	0.28	5.29	28.33	-1.93	-1.26	1.09	8.87	22.88	10.21
28. Basic chemicals	-2.27	-6.06	-4.26	-9.47	-4.95	-3.10	-7.15	-6.61	0.31	-3.83	-8.53
29. Other chemicals	-1.76	-3.24	0.76	-2.68	-1.80	-2.78	-2.73	-1.26	0.01	-1.05	-3.97
30. Petroleum products	-13.55	-6.82	-5.21	2.16	-2.55	-11.53	1.85	1.55	27.80	-1.10	-5.57

/Table 6 (continued)

Table 6 (continued)

Industry group	Fiji	Hong Kong	India	Indonesia	Malaysia	Papua New Guinea	Philippines	Republic of Korea	Singapore	Sri Lanka	Thailand
32. Ceramics	-1.08	-0.71	0.05	-0.69	-0.67	-0.52	-0.26	0.07	-0.59	-0.05	-0.46
33. Primary iron	-2.96	-2.83	-7.48	-11.26	-6.92	-3.20	-8.49	3.43	-4.92	-2.65	-7.16
35. Primary non-ferrous metals	-0.37	-1.63	-2.42	0.95	14.00	-0.43	-0.20	-1.42	-0.62	-0.55	4.12
36. Fabricated metal	-3.58	1.35	1.46	-4.02	-2.54	-4.93	-2.18	2.01	-1.13	11.55	-2.01
37. Machinery	-4.81	-1.69	-8.36	-10.34	-10.50	-19.03	-12.86	-5.09	-5.20	-2.73	-14.48
38. Electrical machinery	-1.22	0.17	-1.93	-5.23	-2.93	-2.76	-2.81	1.23	0.97	-0.35	-3.77
39. Automobiles	-2.65	-1.25	-0.39	-9.56	-9.58	-6.06	-6.24	-1.23	-0.99	-1.41	-7.67
40. Other transport equipment	-0.49	-0.35	-1.07	-2.75	-1.25	-1.95	-3.92	-5.49	-1.22	-0.61	-2.46
41. Instrument and related products	-1.98	-0.30	-0.31	-0.74	-2.29	-0.74	-0.51	0.07	-0.32	-0.12	-0.49
42. Miscellaneous manufacturing	-11.71	16.21	1.64	-4.58	-4.22	-5.25	6.17	5.34	-1.84	-0.60	-2.81
	0	0	0	0	0	0	0	0	0	0	0

Sources: United Nations, Commodity Trade Statistics, 1974; Papua New Guinea Bureau of Statistics, International Trade Statistics, 1974/75.

Notes: a/ Calculated as export value of product as percentage of total country or area, exports minus import value of product as percentage of total country imports. Negative value indicates net imports.

/Table 7.

Table 7. Impact on the terms of trade of relative price movements suggested by United States pollution control costs: eleven ESCAP countries and areas, 1974

Country	Export value percentage change	Import value percentage change	Terms of trade percentage change
Fiji	2.42	1.82	+0.59
	0.44 a/	1.82	-1.35 a/
Hong Kong	1.00	2.00	-0.98
India	1.74	1.93	-0.19
Indonesia	1.23	2.31	-1.06
Malaysia	1.88	2.00	-0.12
	1.48 b/	2.00 b/	-0.51 b/
Papua New Guinea	1.66	2.10	-0.43
	1.18 c/	2.10 c/	-0.90 c/
Philippines	1.99	2.02	-0.03
	1.31 a/	2.02 a/	-0.70 a/
Republic of Korea	1.08	1.71	-0.62
Singapore	2.57	1.68	+0.88
Sri Lanka	2.09	0.79	+1.98
	0.96 d/	0.79 d/	+0.17 d/
	0.63 b/ d/	0.79 b/ d/	-0.16 b/ d/
Thailand	2.12	1.93	+0.17
	1.25 e/	1.93 e/	-0.67 e/

Sources: As for tables 4 and 6.

Notes: a/ Excluding sugar.
b/ Excluding rubber.
c/ Excluding coffee.
d/ Excluding tea.
e/ Excluding rice.

/Table 8.

Table 8. Impact on the terms of trade of relative price movements suggested by Japanese pollution control costs: eleven ESCAP countries and areas, 1974

Country	Export value percentage change	Import value percentage change	Terms of trade percentage change
Fiji	0.31	3.44	-3.03
	0.15 a/	3.44 a/	-3.18 a/
Hong Kong	2.95	3.19	-0.23
India	2.70	2.99	-0.28
Indonesia	1.07	3.88	-2.71
Malaysia	2.50	3.80	-1.25
	1.71 b/	3.80 b/	-2.01 b/
Papua New Guinea	0.70	4.06	-3.22
	0.66 c/	4.06 c/	-3.77 c/
Philippines	0.77	3.53	-2.67
	0.71 a/	3.53 a/	-2.72 a/
Republic of Korea	4.76	2.33	+2.37
Singapore	4.42	2.55	+1.82
Sri Lanka	1.10	1.00	+0.09
	1.01 d/	1.00 d/	+0.01 d/
	0.38 b/ d/	1.00 b/ d/	-0.61 b/ d/
Thailand	1.36	3.60	-2.16
	1.28 e/	3.60 e/	-2.24 e/

Sources: As for tables 5 and 6.

Notes: a/ Excluding sugar.
b/ Excluding rubber.
c/ Excluding coffee.
d/ Excluding tea.
e/ Excluding rice.

/Table 9.

Table 9. Paper and pulp production and trade in the ESCAP region

(percentages)

	Paper and board		Pulp	
	Share of ESCAP production	Import dependence a/	Share of ESCAP production	Import dependence a/
Australia	4.6	30.0	3.8	38.0
China	19.7	-0.3	22.5	6.0
India	3.3	21.0	5.5	5.0
Japan	64.4	-1.0	60.3	10.0
New Zealand	2.1	-17.0	4.8	-19.0
Philippines	1.4	0	1.2	23.0
Republic of Korea	2.5	-1.6	0.5	76.0
Thailand	0.6	38.0	0.2	75.0
Total	98.6		98.8	

Source: Calculated from data provided in Food and Agriculture Organisation of the United Nations, Development and Forest Resources in the Asia and Far East Region, 1976.

Note: a/ Proportion of domestic consumption met by net imports - negative values show net exports as proportion of domestic production.

/Table 10.

Table 10. Sources of pulp and pulpwood for the Japanese paper industry, 1973

	Wood pulp (percentage share of total supply)	Pulpwood/chips (percentage share of total supply)
Domestic	90.00	65.30
Developed ESCAP:		
Australia	-	6.94
New Zealand	0.39	0.69
Developing ESCAP:		
Indonesia	-	0.35
Malaysia	-	2.36
Philippines	0.01	0.07
Republic of Korea	-	0.10
Other regions:		
North America	8.23	20.06
USSR	0.28	3.96
Western Europe	0.93	-
Total	99.84	99.83

Source: Calculated from data provided in Food and Agriculture Organisation of the United Nations, Development and Forest Resources in the Asia and Far East Region, 1976.
