The United Nations University

INTECH

Institute for New Technologies

Discussion Paper Series

#9801

Environmental Regulation And International Competitiveness: A review of Literature and Some European Evidence

Rhys Jenkins

January 1998

Revised version of a paper prepared for the Workshop meeting of the research project on Environmental Regulation, Globalization of Production and Technological Change, UNU/INTECH, Maastricht, 14-15 March, 1997.

United Nations University, Institute for New Technologies, Keizer Karelplein 19, 6211 TC Maastricht, The Netherlands
Tel: (31) (43) 350 6300, Fax: (31) (43) 350 6399, e-mail: postmaster@intech.unu.edu, URL: http://www.intech.unu.edu

1. Introduction

The impact of environmental regulation on competitiveness is a major issue of concern to policy makers. It has also been the subject of considerable academic debate in the last few years between those who see an inherent conflict between the protection of the environment and international competitiveness, and those who believe that environmental regulation can in fact improve economic performance.

The conventional economic approach assumes that there is a trade-off between environmental regulation and competitiveness. Regulation is a means whereby environmental costs are partly or wholly internalized. Firms undertaking additional expenditures in order to abate pollution and reduce environmental damage will therefore tend to have higher costs than those which do not. At the international level this implies that producers in countries with more stringent environmental controls will be less competitive than those in countries which take a laxer approach towards protection of the environment.[1] This takes a North-South dimension in so far as it is usually assumed that developing countries tend to have lower environmental standards or to enforce their standards less strictly than the advanced industrial countries.

While this approach assumes an inherent conflict between environmental regulation and competitiveness, the reverse hypothesis, that regulation can promote competitiveness, has gained currency in recent years. This derives from a more dynamic view of competitiveness which gives a central role to technological change (EC, 1992). This 'win-win' view has been espoused not only by the European Commission, but also by US Vice President Al Gore (1992), the World Bank (1992) and Michael Porter (1991; Porter and van der Linde, 1995, 1996). A corollary of this perspective for developing countries is that a high standard of environmental protection will be a source of competitive advantage in the future (West and Senez, 1992, pp.69-70).

In the context of this debate, the purpose of this paper is threefold. It seeks first of all to clarify some of the different meanings which have been given to the term "competitiveness" and the different domains within which it has been analysed. Second it reviews some of the empirical literature on the relationship between environmental impacts and competitiveness. Finally it

[1] Jaffe et. al. (1993) present a simple analytical model to illustrate this point.

describes a framework for analysing environment-competitiveness interactions and applies this to data from the European Union.

The next section presents the debate over the impact of environmental regulation on competitiveness. This begs the question of what is meant by the term "competitiveness" and the level at which it is applied. Section 3 therefore addresses this issue. In Section 4 a number of empirical studies of the link between environmental regulation and competitiveness are reviewed. In view of the somewhat inconclusive results of these studies, Section 5 presents a framework for analysing the determinants of environment-competitiveness linkages at the industry level. Finally Section 6 presents some preliminary results based on EU data.

2. The Debate

The two sides of the debate over the relationship between environmental regulation and competitiveness identified above present a number of conflicting arguments. The conventional economic approach assumes not only that environmental regulation leads to higher costs, but also that it diverts capital resources away from other potential projects in favour of investment to reduce pollution, and that it will therefore reduce productivity growth. Finally, compliance with strict environmental regulation, as well as absorbing financial resources, may take up a significant proportion of management's time, reducing its availability for other tasks (cf. Walley and Whitehead, 1996).

This negative impact on competitiveness can lead to a number of possible outcomes. First firms affected in this way will tend to lose market share, either in their home market or in the international market, to firms based in less regulated markets, particularly in newly industrializing countries or transition economies. Second, faced with increased operating and investment costs in developed countries with relatively strict environmental regulation, they may choose to relocate production or concentrate new investment in less regulated jurisdictions. Such industrial flight has been a major theme in the literature on the international implications of environmental regulation (Leonard, 1988; Knutsen, 1995). Third, they may decide to cease production of the more polluting products altogether, concentrating on those areas of their activity which is less affected by environmental regulation.

In contrast, the revisionist view criticizes the static nature of the conventional approach arguing that innovation to reduce environmental damage often leads to reduced costs and increased

competitiveness. These "innovation offsets" can arise in a number of ways. From a physical point of view, pollution is simply a form of waste generated in the production process. Environmental regulation which leads the firm to seek ways of increasing resource productivity in order to reduce such waste, will also reduce the costs of inputs. Alternatively regulation may lead the firm to find ways of converting the waste into saleable products which provide additional revenues (Porter and van der Linde, 1996). Thus environmental regulation can either reduce costs or increase revenues and hence improve competitiveness.

Central to the win-win view is the belief that environmental regulation promotes innovation at the firm level. This may lead to changes in production which reduce costs by using cheaper materials or adopting different processes. Moreover the firm which leads in introducing more environmentally friendly technology may enjoy a "first mover advantage" vis-a-vis laggards who continue to use traditional production methods.

A further way in which competitiveness may be increased is where a firm is able to obtain a niche market by producing a "greener" product. This can be seen as a form of product differentiation which enables the company to charge premium prices for its product, compared to less environmentally friendly products. Some firms have indeed established their market position on the basis of their environmental image (the Body Shop is a case in point).[2] Increased environmental awareness amongst consumers and the growth of eco-labelling may increase the importance of such considerations in the future.

Another way in which stricter environmental regulation may contribute to competitiveness is through the development of a new industry producing pollution monitoring and control equipment (Sorsa, 1994; OECD, 1996). Again a country which is in the forefront of environmental regulation is likely to give its environmental equipment industry a first mover advantage in international markets. In the case of the European Union, Germany provides a good example of this, especially within the solid waste and waste water sectors.

The advantages of stringent environmental regulation apply not only in the advanced countries. In developing countries the social stress and health problems caused by the neglect of

[2] It may also be possible for a company to create a "green" image through its marketing efforts without a significant change in its product.

environmental protection can lead to lower productivity, enhanced uncertainty for investment and increased social instability from acute air and water problems. Governments should therefore avoid the temptation of becoming pollution havens in order to attract foreign capital since low environmental standards can be a disincentive to investment. They should rather enforce domestic environmental standards and seek to encourage the transfer of clean technologies (West and Senez, 1992, pp.69-70).

A further factor which may lead to good environmental performance contributing to competitiveness in developing countries is the growth of eco-labelling and the development of international environmental management standards (particularly ISO 14000). Companies which fail to meet certain environmental standards may face increased difficulties in terms of market access and market acceptance when they seek to export to the North (UNCTAD, 1994b).

Critics point to a number of weaknesses of the revisionist approach. It implies that there are extensive opportunities for cost reducing innovations which would not be adopted in the absence of regulation. Orthodox economists find this somewhat difficult to accept arguing, that if the opportunities are as extensive as the revisionists suggest, they would be taken up whether or not there was regulation. There may be some "low hanging fruit" (i.e. low cost opportunities for improving environmental performance) but the costs of pollution abatement tend to rise sharply as pollution is reduced, so that negative effects on competitiveness would soon be felt. Finally even if it is shown that innovation promoted by environmental regulation reduces costs, there is an opportunity cost in terms of the potentially more productive investments or avenues for innovation foregone (Jaffe et. al., 1993, p.32; Palmer et. al., 1995; Walley and Whitehead, 1996).

Although it is possible to present the conventional and the revisionist views as polar opposites, the former as a static approach which assumes that there will always be trade-offs between the environment and competitiveness, and the latter as a dynamic approach where all conflicts are brushed aside, it is more useful to see the differences between them in terms of the extent to which such dynamic complementarities can offset static trade-offs. There are two aspects to the debate at this level.

First there is disagreement as to the prevalence of the "innovation offsets" emphasized by the revisionists. Palmer et. al. (1995, p.120) acknowledge "that regulations have sometimes led to the

discovery of cost-saving or quality-improving innovations" but question the pervasiveness of such effects. Porter and van der Linde (1995, p.98) however claim that,

> "Innovation offsets will be common because reducing pollution is often coincident with improving the productivity with which resources are used."

and later that

> "the opportunity to reduce cost by diminishing pollution should thus be the rule, not the exception" (p.106).

There is a second implicit difference between the two sides concerning the time horizon over which innovation offsets are realized. The revisionists claim that environmental improvements have very short pay back periods. Others are more cautious however. Bruce Smart comments that,

> "Pollution prevention does pay a prompt return on investment - in some cases." (Various Authors, 1996, p.52).

There is a question therefore, not only of how general are the situations which give rise to cost reductions in response to environmental regulation, but also of how long it takes for the dynamic benefits to offset the static losses where both occur.

An example can help illustrate these two aspects. In an industry where "end-of-pipe" methods are the lowest cost means of meeting pollution abatement obligations, it is unlikely that there will be any cost reduction as a result of environmental regulation. However where new cleaner production processes are developed it is quite feasible that these processes will reduce both environmental damage and production costs. Thus the technological options available in different industries may affect the trade-off between environmental protection and competitiveness. Where a new process is introduced this may still, in the short run, lead to higher costs than with traditional, more polluting production methods, however over time, as a result of learning, costs will tend to fall with the new process so that in the long run it may indeed have lower costs than the previous method. In this case the speed with which learning reduces costs becomes a key factor.

Once it is recognised that the win-win proponents do not claim that all environmental regulation whatever its form or strictness leads to increased competitiveness, and that the trade-off view does not deny the possibility that in some cases it may be possible to obtain benefits in terms of both environment and competitiveness, it then becomes possible to focus on the more interesting

question of the conditions under which environmental regulation increases or reduces competitiveness (and the type of environmental regulation which is most likely to achieve this).

3. Meanings of Competitiveness

The concept of competitiveness is used at a number of different levels and often the differences between these notions of competitiveness are not given sufficient emphasis. These differences are important, not only for conceptual clarity but also in order to develop appropriate measures of competitiveness.

a) The Firm Level

The most obvious level at which the notion of competitiveness can be applied is that of the firm. It is after all firms which compete with one another in the market place. Management textbooks focus on competitive strategy and ways in which firms can increase their competitiveness. "Bench marking" against competitors has become an important tool for improving business performance.

The meaning of competitiveness at the firm level is fairly clear. In the US the President's Commission on Industrial Competitiveness defined it in the following terms.

> "A firm is competitive if it can produce products or services of superior quality or lower costs than its domestic and international competitors. Competitiveness is then synonymous with a firm's long-run profit performance and its ability to compensate its employees and provide superior returns to its owners." (quoted in Francis, 1989, pp.15-16).

This suggests a number of different ways in which the impact of environmental regulation on competitiveness at the firm level might be evaluated. One possibility is to compare the costs of production of plants producing the same product but with different levels of emissions or discharges. A limitation of this approach is that it concentrates on only one aspect of the competitiveness equation, namely costs, while not taking into account issues of quality.

A more direct approach is to compare a firm's environmental performance with various measures of profitability (return on sales; return on assets; return on equity). Alternatively, since measures of profitability may be affected by other factors such as market power, some measure of productivity (total or single factor productivity) may be used as a proxy for competitiveness on

the assumption that a firm with a high level or growth rate of productivity is likely to be in a favourable competitive position.

b) The Industry Level

The level of the individual firm may not however provide a good indicator of the overall impact of environmental regulation on competitiveness. Firms compete against each other and some of the competitive gains which a firm may make through becoming more environmentally sound may be at the expense of other firms. Not all firms can benefit from being first movers or from exploiting niche markets.

A better indicator of the impact of environmental regulation on competitiveness can therefore be obtained by looking at the industry level. The competitiveness of an industry is best defined in relation to the industry in other countries. Indeed one way of looking at the concept of competitiveness here is the relative attractiveness of different countries as locations for a particular industry.[3] The concerns that are raised at the industry level are that industries which have high pollution abatement costs in a country will lose out to those from less regulated locations.

At the industry level therefore competitiveness is usually related to performance in international trade. A variety of different measures are used based either on total exports or net exports (export minus imports). These are then normalized depending on the type of measure of competitiveness which is required. These are often referred to as measures of Revealed Comparative Advantage (RCA) (Ballance, 1988; Greenaway and Milner, 1993, Ch.10). An alternative approach is to look at international investment flows to see whether there is evidence of capital from the more polluting industries flowing to countries where environmental regulation is relatively lax.

In analysing competitiveness at the industry level, it is important to bear in mind not only to look at the impact on those industries where environmental regulation is likely to have a direct effect, but also to take into account the competitive position of new industries which may emerge

[3] An alternative definition of industry competitiveness might be vis-a-vis other industries in the same country. While in a closed economy it might make sense to think of industries competing with each other for labour and capital, in an increasingly globalized economy it makes more sense to think of countries competing with each other for a particular industry.

producing pollution control and monitoring equipment. Such developments will reveal themselves at the national level where losses in one industrial sector may be offset by gains in another.

c) The National Level

By its very nature the concept of competitiveness at an industry level is a partial one and this is an important limitation. Where regulation internalizes an environmental externality, this may mean an increase in the competitiveness of an industry whose costs were previously higher because of the negative effects of the non-regulated industry on the environment.[4] There is therefore an argument for saying that the impact of regulation on competitiveness should be considered at the level of the economy as a whole.

The notion of competitiveness at the national level has come into increasing use. International Management Development and World Economic Forum publishes an annual "World Competitiveness Yearbook" which ranks the leading economies in terms of indicators of national competitiveness (IMD/WEF, 1996). Numerous official reports have addressed the problem of competitiveness of particular countries (e.g. US GPO, 1985; HMSO, 1985; EU, 1993). Moreover governments frequently remind their populations of the need to be internationally competitive, often in order to justify unpalatable measures such as wage restraint or cuts in public expenditure.

Despite frequent usage, the definition of competitiveness at the national level is much less clear than for firms or industries. Some economists even deny that national competitiveness has any meaning. At the end of a trenchant critique, Paul Krugman (1994, p.44) concludes,

> "competitiveness is a meaningless word when applied to national economies. And the obsession with competitiveness is both wrong and dangerous."

Most writers on national competitiveness agree that a broader definition than one based solely on trade performance is required, but believe that such a definition is meaningful. International Management Development define competitiveness as

[4] An example would be an industry which has to treat water which it uses in its production process because of upstream contamination by another industry.

> "the ability of a country to create and added value and thus increase national wealth by managing assets and processes, attractiveness and aggressiveness, globality and proximity, and by integrating these relationships into an economic and social model" (IMD/WEF, 1996, p.42).

At almost as high a level of generality, Tyson (1992) defines competitiveness in terms of

> "our ability to produce goods and services that meet the test of international competition while our citizens enjoy a standard of living that is both rising and sustainable" (quoted in Krugman, 1994, pp.31-2).

Porter is rather more specific, stating that

> "The only meaningful concept of competitiveness at the national level is national productivity. A rising standard of living depends on the capacity of a nation's firms to achieve high levels of productivity and to increase productivity over time". (Porter, 1990, p.6)

What then are the most appropriate indicators of competitiveness at the national level? The World Competitiveness Report identifies 224 criteria which it groups under eight factors. These criteria include unit labour cost; R & D spending; inward and outward investment; growth rates; education levels; infrastructure. However, although these indicators are all measures which it is believed contribute to national competitiveness, many are measures of inputs rather than outputs. When one seeks measures of performance, a rather narrower range of indicators appear to be directly relevant. The US Commission on Industrial Competitiveness focused on four such indicators: labour productivity; real wage growth; real returns on capital employed; position in world trade. Some authors argue that, since labour makes up a significant part of total costs, relative unit labour costs can be used as a proxy for competitiveness. This in turn depends on three factors, the level of wages, the exchange rate and the level of productivity (cf. Fröhlich, 1989). Moreover since increased competitiveness through either reduced wages or devaluation imply a decline in the standard of living, only productivity can be used as an indicator of competitiveness in the broader sense used by Tyson and Porter.[5]

[5] This is of course open to the criticism that productivity is a measure of efficiency rather than competitiveness (see Francis, 1989). However it seems to me the only measure which provides a meaningful indicator of competitiveness at the national level.

This suggests then that the most suitable indicators of national competitiveness are the growth of per capita national income, or total factor productivity growth for the economy as a whole. When considering the impact of environmental regulation it has been argued that it is necessary to modify the conventional measures of national income and productivity growth in order to include the benefits associated with reduced environmental damage in the measure (see below).

4. Empirical Studies of Environmental Regulation and Competitiveness

a) Firm level

The question that is addressed in studies which focus on the individual firm, is whether firms which perform well in environmental terms tend also to have a better economic performance as the Porter hypothesis would imply. Given the limited availability of data on environmental performance at the firm level, there are relatively few empirical studies which have addressed the issues at this level. Most of those which do exist have concentrated on a relatively small number of industries and are predominantly US based.

One group of studies has focused on the link between environmental performance and profitability. In the United States some early studies were undertaken in the 1970s using a Council of Economic Priorities data base of firms in oil refining, steel, pulp and paper and electricity. These found that there was a positive correlation between pollution control and profitability, however it has been noted that the database used referred to 1972, before a major tightening of environmental regulation in the US (Jaggi and Freedman, 1992). Although the existence of such a correlation is consistent with the revisionist view that reducing pollution increases profitability, it may be the case that the causation runs the other way with the more profitable firms being better able to spend on pollution abatement, or there may be a third factor such as firm size which is correlated with both profitability and pollution control.

Jaggi and Freedman's (1992) own study of the pulp and paper industry found a weak negative relationship between some economic performance indicators and water pollution at the firm level. However for the key indicators of return on equity and return on assets the correlation is never significant, and for some periods it is positive rather than negative. Similarly a study of a sample of transnational corporations found that firms with larger reductions in toxic emissions tended to have a worse financial performance, although again the relationship was not statistically significant (Levy, 1995).

A larger study of 127 large US firms came to the opposite conclusion finding that there was a positive relationship between reductions in emissions and subsequent profitability, and that this relationship was particularly marked for the firms with the highest level of pollution (Hart and Ahuja, 1996). Again the question of possible reverse causality arises and the authors indicate that this will need to be addressed in future work. Another study of large US firms came to similar conclusions, again without ruling out the possibility of reverse causality (Russo and Fouts, 1994 quoted in Levy, 1995).

The most comprehensive study so far of the profitability-environmental performance relationship was based on data for almost 2000 plants in the United States (Repetto, 1995). This found that there was very little relationship between pollution levels (in terms of toxic releases, water discharges or air particulate emissions) and either returns on capital or sales. At the industry level, correlations were as likely to be negative (supporting the Porter hypothesis) as positive, but in most cases were not statistically significant. There are several limitations to this study, particularly the fact that it is based on data for a single year, the adequacy of the profitability measures, and the issue of causality.

As far as the link between profitability and environmental performance is concerned, there is so far insufficient evidence to assess the validity of the contending views. This is obviously an area that requires more research. The recent studies by Hart and Ahuja (1996) and Repetto (1995) point the way for further empirical work.

This is even more true in the case of the relationship between pollution and productivity at the firm level, where there has only been one major empirical study. A paper by Gray and Shadbegian (1993) of plant-level productivity in the pulp and paper, oil refining and steel industries found a negative relationship between environmental compliance costs and both the level and growth of productivity, and that regulated plants had lower levels of productivity and slower productivity growth than less regulated plants (quoted in Jaffe et. al., 1993, p.74).

b) Industry level

At the industry level competitiveness is usually related to performance in international trade. Three types of studies which attempt to evaluate the impact of environmental regulation on competitiveness can be identified here. The first type looks at international trade patterns to see whether pollution intensive industries are performing better in countries with less stringent

environmental regulations. The second type looks at one particular country and considers the composition of its exports and imports in terms of pollution intensity. The third approach focuses on investment flows rather than trade flows, looking at whether there is a tendency for capital in the most polluting industries to flow out of those countries with stringent regulations towards less regulated jurisdictions.

(I) Overall trade patterns

Several recent studies have looked at the pattern of international trade, comparing pollution intensive industries with less polluting industries. The hypothesis here is that "dirty" industries will lose competitiveness in countries which have adopted stringent environmental controls and that this will be reflected in a shift towards less regulated economies, usually identified with less developed countries.

A first indicator of these changes is the share of different country groupings in exports of pollution-intensive goods. Despite differences, for example in terms of the precise time period covered, the classification of industries as pollution intensive, the degree of disaggregation of data etc., three studies using this approach produce very similar results. They all find that the share of the advanced industrial countries in such industries has tended to fall, while that of developing countries has been increasing (Low and Yeats, 1992, Table 6.2; Sorsa, 1994, Table 2 and p.7; UNCTAD, 1994a, p.11)

These studies also use the Balassa measure of Revealed Comparative Advantage as modified by Yeats to analyse changes in trade patterns.[6] The RCA index is higher in advanced industrial countries in "dirty" industries than in LDCs throughout the periods covered (the 1970s and 1980s). However the average RCA is declining in the OECD countries and increasing in developing countries, and in individual pollution intensive industries the pattern is replicated with the majority of such industries in LDCs showing increasing RCAs while in developed countries most are decreasing.

These results would seem to support the view that developed countries lost competitiveness in environmentally sensitive industries during the period in which regulation was tightened

[6] The Balassa RCA measures a specific country's comparative advantage in different industries, while Yeats modification focuses on different countries' comparative advantage in a specific industry (see Yeats, 1985).

decisively. The authors are all cautious however in concluding that the observed changes in trade patterns are a result of environmental regulation in the advanced industrial countries. Both Low and Yeats (1992) and UNCTAD (1994a) recognise that although their data is consistent with this view, alternative explanations are equally plausible e.g. that it is the normal pattern of industrial growth at early stages of industrialization. Sorsa (1994, p.i) concludes even more strongly that,

> "Other factors are likely to have been more important than differences in environmental expenditures in explaining trade patterns in environmentally sensitive industries. Competitiveness is influenced by a complex interaction of a number of macro- and micro-economic factors."

Other writers have used more formal trade models to analyse the impact of differences in environmental regulation on trade flows. Tobey (1990) introduces the stringency of national environmental regulation as an additional variable in a Hecksher-Ohlin-Vanek trade model to predict net exports in five polluting industries (mining, paper, chemicals, steel, non-ferrous metals). In contrast to the other studies mentioned he finds no empirical evidence to support the view that differences in environmental regulation have an impact on trade, although both the crudeness of the proxy for environmental controls and the level of aggregation of the study may have been factors in this result.

Using a gravity flow model of international trade van Beers and van den Bergh (1997) replicated Tobey's results when they use his (input based) measure of environmental strictness. However when they used an output based measure of the stringency of environmental regulation, they found that this does have a negative effect on exports of non-resource based dirty industries. A major limitation of this study however is that it only included developed OECD countries and hence excluded those countries which would be expected to have the laxest regulation.

(ii) Studies of individual countries

A second type of study looks at an individual country and compares export performance in pollution-intensive industries with that in other industries in order to assess the competitive effects of environmental regulation. Again most of the studies which have adopted this approach have looked at the United States, either its multilateral trade, or its trade with its neighbours, Mexico and Canada.

Kalt (1988) concludes that the United States lost competitiveness in pollution-intensive manufacturing industries between the late 1960s and the late 1970s as a result of increased compliance costs. Perhaps surprisingly this result was even more marked when the chemical

industry was excluded from the analysis. Robison (1988) also found that the average pollution-intensity of US imports increased relative to its exports between the early 1970s and the early 1980s, again suggesting a relative loss of competitiveness in more polluting industries. He also found that there was no such trend in bilateral trade with Canada which had similarly strict environmental regulations.

Two studies have looked specifically at trade between the USA and Mexico, on the grounds that there are significant differences in environmental regulation between the two countries and if pollution abatement costs are a significant factor in competitiveness, this should be reflected in the pattern of US Mexican trade. Low (1992) finds that dirty industries account for a relatively small share of Mexican exports to the United States, although their share did increase from 8.6% to 11.1% over the 1980s. Grossman and Krueger (1991) found that US pollution abatement costs, although positively related to Mexican imports, were not statistically significant (the study only looked at the level of imports relative to US shipments in a single year and did not consider changes over time). Thus US trade with Mexico provides only weak evidence that environmental regulation has had a negative effect on competitiveness.

While there is some evidence that the US is losing competitiveness in pollution intensive industries, the country for which there is clearest evidence is Japan. Between 1970 and 1990 its RCA in environmentally sensitive goods declined from 1.2 to 0.6 (Sorsa, 1994, Table 5). A study of Japanese and Indonesian trade confirms the relative pollution intensity of Japanese imports compared to exports, and the way in which this has risen over time (Lee and Roland-Holst, 1994). This appears to have been accompanied by a deliberate strategy of encouraging Japanese industries to migrate to other Asian locations in part because of the need to conserve Japan's own natural environment (Nishikawa, n.d., p.252).

(iii) Investment flows

Unfortunately data on foreign investment is never available with anything like the kind of disaggregation which is obtained in trade statistics. As a result attempts to analyse empirically the relationship between environmental regulation and international capital flows are bound to be relatively crude.

Two types of study have a bearing on the issue of competitiveness. One looks at the pattern of foreign investment in pollution intensive industries to see whether there has been a shift in investment away from countries with strict environmental regulation towards laxer jurisdictions.

The other type of study focuses on the determinants of investment decisions either through surveys or econometric studies.

The evidence here is even less clear cut than in the case of trade studies. Looking at the overall pattern of direct foreign investment, there is little evidence that investment in less developed countries has grown particularly rapidly in the most polluting industries. During the late 1970s and 1980s the share of the main polluting industries (chemicals, pulp and paper, petroleum and coal products, and metals) in total outward investment showed no consistent pattern amongst the major developed countries (UN, 1992, Table IX).

The most detailed analysis of trends in foreign investment has been carried out by Leonard (1984, 1988) on US investment. The conclusion of his studies is that environmental regulation has had little impact on competitiveness overall, although in certain specific cases it may have been an important factor. Ferrantino (1995) has updated this analysis to the early 1990s and again found no shift in US investment in pollution-intensive industries towards developing countries.

The other type of evidence concerning the possible impact of environmental regulation on competitiveness comes from the analysis of firm foreign investment decisions. If indeed environmental regulation was an important determinant of competitiveness, then it would have an influence on investment decisions. Econometric studies of the determinants of investment do not generally include an environmental variable, reflecting the difficulty of finding a suitable proxy.[7] Some surveys have included questions on the significance of either stringent environmental regulation at home, or laxer regulation overseas as a factor in investment decisions. These have generally found that other factors are far more important determinants of investment (Knodgen, 1988; Blazejczak, 1993).

The pattern revealed by industry level studies is interesting but again not conclusive in terms of the environment-competitiveness debate. There is some evidence that developed countries are losing competitiveness in pollution-intensive industries while less regulated developing countries are becoming more competitive in these industries (as measured by trade indicators). What these

[7] One exception is a preliminary study by Kolstad and Xing (1994) (quoted in Jaffe et. al. (1995), p.147). This found a positive relation between inward investment in the chemical industry and sulphur dioxide emissions, per dollar of GDP, which was used as a proxy for environmental laxity.

studies have not established is whether there is a causal link running from stricter environmental controls to declining competitiveness. In the case of direct foreign investment, it is much less clear that environmental factors play a key role in location decisions, although it must be remembered that TNC strategies may involve international sourcing which is not reflected in foreign investment flows (cf. Knutsen, 1995).

c) National level

Although the main concern of this paper is with competitiveness at the firm and industry level, it is important to bear in mind that these are partial analyses, and that any overall evaluation of the implications of environmental regulation needs to consider the macro-economic dimension.

As discussed above, the most meaningful concept of competitiveness at the national level is either a measure of productivity or possibly of per capita income growth. There have been numerous macroeconomic studies of the impact of environmental regulation, however since these are less relevant to the questions which we wish to address here, they will not be discussed in detail.

A study by the OECD (1985) of six member countries (Austria, Finland, France, Netherlands, Norway and the United States) concluded that the impact of environmental regulation on economic growth was relatively small and could in some cases be positive. Similar conclusions were arrived at by Portney (1981) reviewing US studies of the macroeconomic impacts of regulation.

The problem with such studies is that they included the cost of environmental regulation without including the benefits. They measure GDP in conventional terms whereby environmental damage may contribute to income (e.g. because of clean-up costs) whereas environmental improvements (e.g. through increased energy efficiency) may appear as a reduction in income. It is concerns such as these which have led to a move to develop "green" national accounts and estimates of "sustainable" national income.

A similar point can be made in relation to studies of environmental regulation and productivity at the national level. A number of studies in the United States have claimed that environmental regulation has been a factor contributing to the productivity slowdown of the 1970s and 1980s. At the level of the manufacturing sector as a whole, estimates of the contribution of environmental regulation to the overall reduction in productivity growth range from 8% to 16%

(Jaffe et. al., 1995, p.151). Repetto et. al. (1996) argue that conventional measures of productivity used in such studies are biased against environmental protection since they do not incorporate the environmental damage avoided as a result of stricter environmental regulation. He shows empirically how this leads to significant changes in measured productivity performance in certain US industries.

These studies at the national level serve to remind us of two points. First in purely economic terms the loss of competitiveness in those industries which are negatively affected by environmental regulation may be offset by gains in other industries where competitiveness is increased, so that the net effect on competitiveness for the economy as a whole may be relatively small. Second, although there may be a loss in competitiveness as conventionally measured, in welfare terms these need to be set against the gains from reduced environmental damage which results from stricter regulation, which is not captured in conventional economic indicators.

5. Determinants of Environment-Competitiveness Linkages

Although the theoretical literature on the impact of environmental regulation on competitiveness polarizes the debate around two opposing positions, the conventional wisdom and the revisionist view, the empirical literature discussed in the last section does not give clear support to either of these views. There is some evidence that is consistent with the view that environmental regulation may lead to loss of competitiveness, but this is also open to other interpretations. There are similarly examples where environmental regulation leads to increased competitiveness but again these do not appear to be sufficiently widespread to show up in more general studies.

A more useful way forward in terms of research therefore is to consider the reasons why the impact of environmental regulation on competitiveness may differ according to particular circumstances. In what follows we consider particularly the reasons why different industries may show different interactions between regulation and competitiveness. It is also likely that the nature of regulation will have different implications for competitiveness, reflecting the relative efficiency of different instruments. Although this is an important issue, it is not our principal concern in what follows.

The first factor determining the differential impact is the extent to which industries create environmental damage. The environmental impact of industries clearly differ considerably from branch to branch. For example in the US toxic releases per $1,000 of shipments (weighted by risk

to humans) was almost 500 times greater in the most toxic industry, Fertilizers and Pesticides, as it was in the last industry, Soft Drinks (Hettige et. al., 1995, Table 4.1). Similar massive inter-industry differences also occur for atmospheric emissions and water discharges.

Differences in pollution-intensity will necessarily give rise to differences in abatement costs between industries. For instance in the United States the ratio of pollution abatement operating cost to value of output varies from 3.17% in the cement industry to 0.01% in printing and publishing. These differences depend not only on the environmental damage associated with different industries, but also on the cost of the different technologies available to reduce or treat emissions, discharges and waste, and the strictness of environmental regulation and implementation affecting different industries.

Although figures on the share of pollution abatement in operating cost are relatively low, the proportion of investment devoted to pollution control is usually much higher. In the late 1980s and early 1990s pollution control accounted for 3.5% of capital expenditure in Japan, 4.5% in the Netherlands and 5.5% in the US (UNCTAD, 1994a, p.10). These averages hide much higher figures, well into double figures, for the most polluting industries such as chemicals and basic metals.

The impact of investment in pollution control equipment on competitiveness depends not only on the operating costs of available technologies but will also be influenced by the importance of sunk costs in the industry, which makes it necessary for existing assets to be written off. For individual firms it will also depend on the point in the firm's investment cycle at which it has to undertake new environmental investments (Stevens, 1993, p.11). Capital intensive industries such as pulp and paper, oil refining and basic chemicals are likely to find competitiveness affected much more than light industries such as food processing or footwear.

Another factor which will determine the extent to which environmental regulation leads to cost increases is the extent of innovation within the firm or industry. The argument that regulation leads to "innovation offsets" is more likely to apply where there is substantial innovatory activity. Bearing in mind that cost reductions are far more likely to occur where new clean technologies are developed than in industries which adopt end-of-pipe solutions, the level of R&D is likely to be a factor in determining the impact on competitiveness.

For any given level of cost increase, a further important factor is the ability to absorb costs. Profit margins are an important indicator of the ability of an industry or firm to absorb cost increases (Alanen, 1996, p.20). The size of firm, which affects the financial and technical resources available to cope with regulatory requirements, is also a factor in determining the impact on competitiveness (Stevens, 1993, p.11).

The impact of increased costs on competitiveness also depends on the ability to pass on those costs to consumers in the form of higher prices. One determinant of this is market power so that firms in highly concentrated industries are more likely to be able to pass on cost increases than those in atomistic industries. The availability of close substitutes is another factor which influences the elasticity of demand and hence the ability of firms to increase prices without losing sales. A third factor is the market which is supplied (Alanen, 1996, pp.20-21). Where this is a protected local market the firm is more likely to be able to pass on cost increases than where it has to compete in global markets against firms which do not have to meet the same regulatory requirements (Leveque, 1993, p.81).

So far we have only considered the impact of environmental factors on the cost side of the competitiveness equation. However at the firm level particularly, competitiveness depends not only on costs but also on price. If better environmental standards permit firms to obtain higher prices (through marketing "greener" products), independently of cost increases, then there may be further competitive advantages to be gained. For firms to be able to do this, it is necessary first of all that they produce differentiated products rather than homogenous bulk products where competition is based largely on price.

Not all differentiated products necessarily lend themselves to differentiation according to their environmental characteristics however, and some sectors seem to be much more susceptible to environmental attention than others. For example customers worry about the environmental impacts of forest products, but not so much about those of mineral products (Alanen, 1996, p.22). It is probable that consumer goods are more likely to be subject to environmental pressures than industrial goods, although these pressures may focus more on the impact of their use (e.g. energy efficiency) or disposal (e.g. recyclability) than their production (Leveque, 1993, p.80). However, particularly with the growth of eco-labelling and life-cycle analysis, the possibilities of obtaining premium prices or market niches through the production of environmentally friendly products are likely to increase.

This discussion provides the elements for analysing the differential impacts of environmental regulation on competitiveness at the industry or firm level. In the next section this framework will be applied in an analysis of competitiveness in EU industry in recent years.

6. **Trends in Competitiveness in EU Industry**

a) The overall pattern of competitiveness

In order to analyse competitiveness within EU industry, a sectoral indicator was required which could be used to compare trends over time in different industries. A number of alternative indicators were considered, based on net exports as either a proportion of total trade (exports plus imports) or as a proportion of gross production, and the cover ratio (exports divided by imports). The measure finally selected for analysis was the relative cover ratio i.e. the ratio of exports to imports of the sector divided by the ratio of exports to imports for the manufacturing sector as a whole.

A number of factors contributed to the choice of this indicator. First it was available for a greater number of industries than some of the alternative indicators. Secondly normalization by the cover ratio for manufacturing as a whole meant that factors which might have affected manufacturing competitiveness across the board such as exchange rate changes were factored out of the index. Third the cover ratio always takes positive values making it possible to calculate exponential as well as linear trends for the index, which is not the case with measures based on net exports. Thus of the various trade based measures of competitiveness it was felt that it was the most useful indicator of relative trends in the international competitive position of different industries in the EU[8].

Data from the Eurostat Competitiveness Data Base was used to calculate the competitiveness index. The database covers the period from 1980 to 1994. The index was calculated for each year of the period for each 3 digit industry (classified by the NACE) and both a linear and an exponential time trend fitted.

A total of 101 industries were identified of which 35 were classified as dirty industries for the purposes of the current project[9]. Of the 101 industries, 42 showed an improvement in

---

[8] The EU here is defined as the 12 members prior to the accession of Sweden, Finland and Austria.

[9] Industries were identified as pollution-intensive on the basis of information from the World Bank's Industrial Pollution Projection System (Hettige et. al., 1995). This system ranks ISIC 4-digit industries according to a number of key pollutants (toxic releases, SO2, NO2, CO,VOC, particulates, PM10, BOD, TSS). Industries were classified as dirty if they were in the top ten in terms of pollution-intensity (relative to value of output) for at least two pollutants or in the top twenty for at least three. 25 ISIC sectors were identified in this way, and these were correlated with 35 NACE sectors.

competitive performance relative to manufacturing as a whole, and 59 showed a decline in competitiveness. Interestingly when the industries are separated into two groups, 31 of the clean industries showed a better performance than manufacturing as a whole, while 35 did worse. In contrast amongst the dirty industries, only 11 performed better than manufacturing while 24 did worse.

Since the index for manufacturing as a whole shows that EU industry lost competitiveness over the period, this result suggests that there were additional factors at play in some dirty industries which led to an even greater decline in competitiveness. Although this is by no means conclusive evidence that environmental regulation has contributed to loss of competitiveness, it is consistent with this hypothesis.

b) Competitiveness in dirty industries

At the industry level, a number of factors which were discussed earlier will determine the extent to which environmental regulation will lead to increased or decreased competitiveness. In this section we will apply a simplified framework to see how far it can help explain the differences in competitive performance in different industries which have been identified as the most pollution intensive.

The starting point for this analysis is the environment-competitiveness matrix developed by Alanen (1996)[10]. On the cost side we identify two factors which determine the extent to which environmental regulation affects competitiveness. The first is the importance of pollution abatement costs (PAC) relative to output. In the absence of disaggregated data for EU countries we have used US data as a proxy to divide industries into those which have above and below average PACs.

The second factor which we have used is the degree of concentration in the industry. This is taken as an indicator of the ability of firms to pass on or to absorb cost increases - the more concentrated the industry the greater the ability to pass on cost increases to customers. A recent study has estimated European wide concentration ratios for 3-digit NACE industries for the first time and we use this data to classify industries into those with above and below average 5-firm

[10] As is clear from this section and the previous one, the empirical analysis of competitiveness presented in this paper has been largely inspired by Alanen's approach.

concentration ratios (Davies and Lyons, 1996, Appendix 2). Using these two variables, a 2x2 matrix reflecting cost conditions can be constructed, with the least favourable situation arising in the cell where PACs are high and concentration low, and the most favourable situation where PACs are low and concentration high. It is assumed that the other two cells represent intermediate combinations.

The industries identified as being pollution-intensive were classified into three groups according to whether they improved in competitiveness relative to manufacturing as a whole, showed no change or lost competitiveness relative to manufacturing.[11] Industries were then distributed into four cells according to the likely impact of environmental factors on competitiveness[12].

Not surprisingly since all the industries included were classified as "dirty" industries on the basis of their emissions and discharges, the majority of them had high pollution abatement costs, although for several, costs were below average. The industries included were almost equally divided between high and low concentration industries.

The north-east quadrant of the matrix includes those industries in which environmental factors are likely to have the greatest negative impact since it includes those industries which have the highest PACs and are least able to absorb them or pass them on to consumers because of low levels of concentration. The south-west quadrant on the other hand is the most favourable since PACs are below average and concentration is high. The remaining two quadrants represent intermediate positions.

[11] Industries were regarded as improving their competitiveness when the relative cover ratio improved at a rate of 1% per annum or more over the period. Conversely deteriorating competitiveness was a situation in which the relative cover ratio fell by over 1% per annum. Where the change in either direction was less than 1%, the industry was regarded as not having experienced any significant change in its relative position.

[12] Two industries, Coke Ovens (NACE 1200) and Mineral Oil Refining (NACE 1400) were dropped at this point since they are not strictly speaking manufacturing industries and data on EU wide concentration was not available for them.

Table 1: Cost Factors and Environment-Competitiveness Interactions

	Concentration	
PAC	High	Low
High	<u>Performance > mfg.</u> 1. Other chemicals <u>Performance = mfg.</u> 1. Non-ferrous metals 2. Abrasive prods. 3. Basic chemicals 4. Ind & agri. chemicals <u>Performance < mfg.</u> 1. Iron & steel 2. Steel tubes 3. First proc. steel 4. Cement 5. Glass & glassware 6. Synthetic fibres	<u>Performance > mfg.</u> 1. Asbestos 2. Leather 3. Pulp & paper 4. Paper & board converting <u>Performance = mfg.</u> 1. 2ndary metal trans. 2. Other wood manufs. <u>Performance < mfg.</u> 1. Clay prods. 2. Stone & NMM prods. 3. Foundries 4. Forgings 5. Tools & Metal goods 6. Wood building component
Low	<u>Performance > mfg.</u> 1. Oils and fats <u>Performance = mfg.</u> 1. Alcohol & spirits <u>Performance < mfg.</u> 1. Sugar 2. Railroad Equipment	<u>Performance > mfg.</u> 1. Misc. textiles 2. Sawmills & processing 3. Wood board <u>Performance < mfg.</u> 1. Concrete 2. Wood furniture 3. Plastic prods.

A similar matrix can be constructed on the marketing side again using two variables. First the extent to which competition is based on price or on non-price factors, particularly advertising or innovation, affects the competitive implications of environmental regulation. Where price competition dominates, negative effects on competitiveness are more likely; where there is considerable innovation or product differentiation, innovation offsets are more likely. Again we follow Davies and Lyons (1996) classification of industries in distinguishing between the two types.

The second variable on the marketing side recognises that some industries have been more subject to environmental concerns than others, and that in these industries it may be possible for firms to position themselves in the market by emphasizing the environment friendly nature of their activities. Over time the range of industries which have been in the public eye for environmental reasons has broadened. In the 1970s and 1980s the main areas of concern were chemicals (including detergents, fertilizers, pesticides and herbicides, and paints), pulp and paper mills, tropical hardwoods, and asbestos (Pollack, 1995, Figure 2.2). Other industries such as metals and non-metallic minerals (apart from asbestos) have not been the subject of such close consumer and public concern. Thus the first group of industries are classified as being of high environmental concern, while other industries rate as low. Again a 2x2 matrix is constructed with the least favourable quadrant being characterised by undifferentiated products of low environmental concern produced in industries with little R&D, while the most favourable situation in terms of being able to reconcile environmental protection with competitiveness comes in those industries which are highly differentiated or R&D-intensive and have been subject to public concern.

Table 2 shows that the majority of the industries classified as pollution-intensive produce undifferentiated products and are characterised by low R&D-intensity. The vast majority fall into the south-west quadrant which in this case includes the industries which have least possibilities of turning a positive environmental performance into a competitive advantage on

Table 2: Market Factors and Environment-Competitiveness Interactions

	Environmental sensitivity	
Differentiation	Low	High
High	<u>Performance > mfg.</u> 1. Oils & fats <u>Performance = mfg.</u> 1. Alcohol & spirits <u>Performance < mfg.</u> 1. Synthetic fibres 2. Railroad equip.	<u>Performance > mfg.</u> 1. Other chemicals <u>Performance = mfg.</u> 1. Basic ind. chem. 2. Ind. & agri. chem
Low	<u>Performance > mfg.</u> 1. Misc. textiles 2. Leather <u>Performance = mfg.</u> 1. Non-ferrous met. 2. Abrasive prods. 3. 2ndary transf. of metals <u>Performance < mfg.</u> 1. Iron & steel 2. Steel tubes 3. 1st proc. steel 4. Clay 5. Stone & NMM prods 6. Cement 7. Concrete 8. Glass 9. Foundries 10. Forgings 11. Tools & metal products 12. Sugar 13. Plastic products	<u>Performance > mfg.</u> 1. Sawmills & procesing 2. Wood board 3. Pulp & paper 4. Wood & board converting 5. Asbestos <u>Performance = mfg.</u> 1. Other wood prods. <u>Performance < mfg.</u> 1. Wood building components 2. Wood furniture

the marketing side. Conversely, the north-east quadrant includes those industries where environmental factors can most easily be positive because they are industries where there is public concern over environmental performance and in which competition is not based primarily on price considerations. As in the previous table, the other two quadrants represent intermediate situations.

The two 2x2 matrices can now be combined into a 3x3 matrix in which the two axes represent the likely impact of environmental factors on the cost and the market side respectively. These are derived as high, medium and low (negative impacts) from the two previous matrices. For ease of presentation two 3x3 matrices are constructed, one for those industries which performed better than manufacturing as a whole and the other for those industries which performed worse.

Table 3 depicts the situation in those industries which showed a better competitive performance than the manufacturing average. If better competitive performance in these industries reflected a positive interaction between environmental factors and competitiveness, then there would be a tendency for successful industries to be concentrated towards the south-west corner of the table. This is not however the case. The most surprising aspect of this table are the cases of asbestos and leather which despite being classified as sectors subject to high negative effects on both the cost and marketing side, have outperformed manufacturing in terms of competitiveness.

Table 4 presents the situation in the industries where competitiveness has declined even more than manufacturing as a whole. This is more in line with expectations than the previous table in that the bulk of the industries included are in the north-east corner of the matrix. In other words those dirty industries which have performed worst in terms of competitiveness have tended to be badly placed within the competitiveness-environment matrix.

Returning to the matrix for those industries which had the best competitive performance, it can be seen that there was no consistent tendency for those industries to be favoured by environmental factors so that the evidence of a positive environmental effect in industries which do well competitively (the Porter hypothesis) is less strong than that for possible negative effects in industries which perform badly.

Table 3: Environment-Competitiveness Interaction in Industries with Competitive Performance above the Manufacturing Average

	Market Factors		
Cost	Low	Medium	High
High		Pulp & paper Paper & board Asbestos	Leather
Medium	Other chemicals	Wood board Sawmills	Misc. textiles
Low		Oils & fats	

Table 4: Environment-competitiveness Interactions in Industries with Competitive Performance worse than the Manufacturing Average

	Market Factors		
Cost	Low	Medium	High
High		Wood building components	Clay Stone Foundries Forgings Tools
Medium		Synthetic fibres Wood furniture	Iron & steel Steel tubes 1st proc. of steel Cement Concrete Glass Sugar Plastic prods.
Low		Railroad equip.	

A further qualification to this analysis can be introduced by considering the sources of competition for EU production in different industries. The argument that industries which are unfavourably placed in the competitiveness-environment matrix will tend to lose competitiveness applies strictly speaking to competitiveness vis-a-vis other countries which have less stringent environmental regulation. The indicators which have been used in the above analysis are global indices of competitiveness reflecting the EU's trade vis-a-vis the rest of the world. It is possible therefore that in some industries competitiveness has declined vis-a-vis other developed countries which have equally stringent environmental regulation.

When the source of competition is identified the picture is modified somewhat. Three of the seventeen industries where competitiveness declined faced insignificant competition from developing countries (synthetic fibres, railroad equipment, and steel tubes). Of these, only steel tubes was above the diagonal of Table 4, reinforcing the conclusion that industries with declining competitiveness were unfavourably situated in the environment-competitiveness matrix. Three of the industries with competitive performance above the manufacturing average (other chemicals, pulp and paper, and miscellaneous textiles) also faced insignificant competition from developing and transition economies. This leaves only three industries (leather, asbestos, and paper and board) in the anomalous position of having improved their competitiveness, despite their apparently unfavourable conditions.

7. Conclusion

This paper has addressed the relationship between environmental regulation and competitiveness which is central to the current debate on trade and the environment. The review of the literature in Section 4 suggested that there was no strong universal relationship between environmental pressures and competitive performance, either at the firm level or the industry level. In other words neither the conventional wisdom nor the revisionist view receives unambiguous support from the existing evidence.

It is suggested that this reflects the differing impact which environmental regulation may have on economic performance under different circumstances. For instance at the firm level the impact on profitability may be different between large firms, which can take advantage of economies of scale in waste treatment, and small firms where large cost increases may result. It may be the case that firms which are multinational can transfer experiences of pollution reduction between affiliates at minimal costs while non-multinational firms may find access to such information more difficult

and costly. The impact on economic performance may also differ depending on the initial pollution levels, so that where these are initially high, reductions in pollution may be accompanied by efficiency gains and hence higher profitability, whereas when significant reductions in pollution have already been achieved, further gains may only come about at higher costs and reduced profits.

Similarly at the industry level there is apparently no general relationship between environmental regulation and competitiveness. Some industries which have high pollution abatement costs appear to be losing competitiveness within the European Union, while others have been able to maintain or even gain competitiveness. The impact of environmental regulation on competitiveness may differ according to certain structural or market characteristics of the industries concerned. The paper attempts to illustrate this through the use of the environment-competitiveness matrix discussed in Sections 5 and 6.

The efforts to clarify the linkages between environmental regulation and competitiveness are still rudimentary, and it has not been possible to determine conclusively which are the main variables which intervene in the relationship. The evidence presented in this paper can only be illustrative rather than definitive. Moreover environmental regulation is only one of a number of factors which may have an impact on competitiveness and a full analysis would require a much more detail consideration of the impact of other factors.

References

Alanen, L. (1996), The Impact of Environmental Cost Internalization on Sectoral Competitiveness: A New Conceptual Framework, Geneva, UNCTAD Discussion Paper No. 119.

Ballance, R. (1988), "Trade Performance as an Indicator of Comparative Advantage" in D. Greenaway (ed.), Economic Development and International Trade, London, Macmillan.

Blazejczak, J. (1993), "Environmental Policies and Foreign Investment: The Case of Germany" in OECD, Environmental Policies and Industrial Competitiveness, Paris, OECD.

Davies, S. and B. Lyons (1996), Industrial Organisation in the European Union, Oxford University Press.

EC (1992), Towards Sustainability: A European Community programme of Policy and Action in relation to the Environment and Sustainable Development, Brussels, Commission of the European Communities.

Ferrantino, M. (1995), International Trade, Environmental Quality and Public Policy, Washington, US International Trade Commission, Office of Economics Working Paper.

Francis, A. (1989), "The Concept of Competitiveness" in A. Francis and P. Tharakan (eds.), The Competitiveness of European Industry, London, Routledge.

Fröhlich, H-P. (1989), "International Competitiveness: Alternative Macroeconomic Strategies and Changing Perceptions in Recent Years" in A. Francis and P. Tharakan (eds.), The Competitiveness of European Industry, London, Routledge.

Gore, A. (1992), Earth in the Balance: Forging a New Common Purpose, London, Earthscan.

Gray, W. and R. Shadbegian (1993), "Environmental Regulation and Manufacturing Productivity at the Plant Level", Washington, Discussion Paper, Department of Commerce, Center for Economic Studies.

Greenaway, D. and C. Milner (1993), Trade and Industrial Policy in Developing Countries, London, Macmillan.

Grossman, G. and A. Krueger (1991), Environmental Impacts of a North American Free Trade Agreement, National Bureau of Economic Research, Working Paper No. 3914.

Hart, S. and G. Ahuja (1996), "Does it Pay to be Green? An Empirical Examination of the Relationship between Emission Reduction and Firm performance", Business Strategy and the Environment, Vol.5, pp.30-37.

Hettige H., P. Martin, M. Singh and D. Wheeler (1995), The Industrial Pollution Projection System, Washington, World Bank, Policy Research Working Paper 1431.

HMSO (1985), Report of the Select Committee of the House of Lords on Overseas Trade, London, Her Majesty's Stationary Office.

EC (1993), Growth, Competitiveness, Employment: The Challenges and Ways Forward into the 21st Century, Luxembourg, Office for Official Publications of the European Communities.

IMD/WEF (1996), The World Competitiveness Yearbook 1996, Geneva, International Management Development/World Economic Forum.

Jaffe, A., S. Peterson, P. Portney and R. Stavins (1995), "Environmental Regulation and the Competitiveness of US Manufacturing: What Does the Evidence Tell Us?", Journal of Economic Literature, Vol.XXXIII, march.

Jaffe, A., S. Peterson, P. Portney and R. Stavins (1993), Environmental Regulations and the Competitiveness of US Industry, Cambridge, Mass, The Economics Resource Group, Report Prepared for Economics and Statistics Administration, US Department of Commerce.

Jaggi, B. and M. Freedman (1992), "An Examination of the Impact of Pollution Performance on Economic and Market Performance: Pulp and Paper Firms", Journal of Business Finance and Accounting, 19(5).

Kalt, J. (1988), "The Impact of Domestic Environmental Regulatory Policies on US International Competitiveness", International Competitiveness, Cambridge, Mass., Harper and Row.

Knodgen, G. (1988), "Does Environmental Regulation Cause Industrial Flight?" in R.P. Misra (ed.),International Division of Labour and Regional Development, New Delhi, Concept Publishing House.

Knutsen, H. (1995), Polluting industries: 'Industrial Flight' or 'Locational Shift', paper presented to SUM Conference 5-6 October.

Kolstad, C. and Y. Xing (1994), "Do Lax Environmental Regulations Attract Foreign Investment?", Working Paper, Department of Economics and Institute for Environmental Studies, University of Illinois, Urbana, Illinois.

Krugman, P. (1994), "Competitiveness: A Dangerous Obsession", Foreign Affairs, March/April.

Lee, H. and D. Roland-Holst (1994), "International Trade and the Transfer of Environment Cost and Benefits" in J. Francois and K. Reinert (eds.), Applied Trade Policy Modelling, Cambridge University Press.

Leonard, J. (1984), Are Environmental Regulations Driving US Industry Overseas?, Washington, The Conservation Foundation.

Leonard, J. (1988), Pollution and the Struggle for the World Product, Cambridge University Press.

Leveque, F. (1993), "How Can Environmental Policymakers Tackle Industrial Diversity?" in OECD, Environmental Policies and Industrial Competitiveness, Paris, OECD.

Levy, D. (1995), "The environmental practices and performance of transnational corporations", Transnational Corporations, Vol.4, No.1.

Low, P. (1992), "Trade Measures and Environmental Quality: The Implications for Mexico's Exports" in P. Low (ed.), International Trade and the Environment, Washington, World Bank Discussion Paper 159.

Low, P. and A. Yeats (1992), "Do 'Dirty' Industries Migrate" in P. Low (ed.), International Trade and the Environment, Washington, World Bank Discussion Paper 159.

Nishikawa, J. (n.d.), "The Strategy of Japanese Multinationals and Southeast Asia" in CAP, Development and the Environmental Crisis: A Malaysian Case Study, Penang, Consumer Association of Penang.

OECD (1996), The Global Environmental Goods and Services Industry, Paris, OECD.

OECD (1985), The Macro-Economic Impact of Environmental Expenditure, Paris, OECD.

Palmer, K., W. Oates and P. Portney (1995), "Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm?", Journal of Economic Perspectives, Vol. 9, No. 4, Fall.

Pollack, S. (1995), Improving Environmental Performance, London, Routledge.

Porter, M. (1990), The Competitive Advantage of Nations, London, Macmillan

Porter, M. (1991), "America's Green Strategy", Scientific American, April.

Porter, M. and C. van der Linde (1995), "Toward a New Conception of the Environment-Competitiveness Relationship", Journal of Economic Perspectives, Vol. 9, No. 4, Fall.

Porter, M. and C. van der Linde (1996), "Green and Competitive: Ending the Stalemate" in R. Welford and R. Starkey (eds.), The Earthscan Reader in Business and the Environment, London, Earthscan.

Portney, P. (1981), "The Macroeconomic Impacts of Federal Environmental Regulation" in H. Peskin, P. Portney and A. Kneese (eds), Environmental Regulation and the US Economy, Resources for the Future, Johns Hopkins University Press.

R. Repetto, D. Rothman, P. Faeth and D. Austin (1996), Has Environmental Protection Really Reduced Productivity Growth?, Washington, World Resources Institute.

Repetto, R. (1995), Jobs, Competitiveness and Environmental Regulation: What are the Real Issues?, Washington, World Resources Institute.

Robison, D. (1988), "Industrial Pollution Abatement: the Impact on Balance of Trade", Canadian Journal of Economics, XXI, No.1.

Russo, M. and P. Fouts (1994), "The green carrot: do markets reward corporate environmentalism?", University of Oregon, Department of Management, mimeo.

Sorsa, P. (1994), Competitiveness and Environmental Standards: Some Exploratory Results, Washington, World Bank, Policy Research Working Paper 1249.

Stevens, C. (1993), "Synthesis Report: Environmental policies and Industrial Competitiveness" in OECD, Environmental Policies and Industrial Competitiveness, Paris, OECD.

Tobey, J. (1990), "The Effects of Domestic Environmental Policies on Patterns of World Trade: an Empirical Test", Kyklos, Vol.43, No. 2.

Tyson, L. (1992), Who's Bashing Whom: Trade Conflict in High- Technology Industries, Washington, Institute for International Economics.

UN (1992), World Investment Report 1992: Transnational Corporations as Engines of Growth, New York, United Nations, Transnational Corporations and Management Division, Department of Economic and Social Development.

UNCTAD (1994a), Sustainable Development: Trade and Environment - The Impact of Environment-related Policies on Export Competitiveness and Market Access, Geneva, UNCTAD, TD/B/41 (1)/4.

UNCTAD (1994b), International Cooperation on Eco-Labelling and Eco-Certification Programmes and Market Opportunities for Environmentally Friendly Products, Geneva, UNCTAD, TD/B/WG.6/2.

US GPO (1985), The Report of the President's Commission on Industrial Competitiveness: Vol. II Global Competition, The New Reality, Washington, US Government Printing Office.

Van Beers, C. And J. van den Bergh (1997), An Empirical Multi-Country Analysis of the Impact of Environmental Regulations on Foreign Trade Flows , Kyklos, Vol.50, Fasc 1, pp.29-46.

Various Authors (1996), "The Challenge of Going Green" in R. Welford and R. Starkey (eds.), The Earthscan Reader in Business and the Environment, London, Earthscan.

Walley, N. and B. Whitehead (1996), "It's Not Easy Being Green" in R. Welford and R. Starkey (eds.), The Earthscan Reader in Business and the Environment, London, Earthscan.

West, P. And P. Senez (1992), Environmental Assessment of the NAFTA: The Mexican Environmental Regulation Position, Report prepared for the Province of British Columbia, Ministry of Economic Development, Small Business and Trade.

World Bank (1992), World Development Report, 1992, Oxford University Press.

Yeats, A. (1985), "On the Appropriate Interpretation of the Revealed Comparative Advantage Index: Implications of a Methodology Based on Industry Sector Analysis", Weltwirtschaftliches Archiv, 121.