

EXPORT PERFORMANCE OF ENVIRONMENTALLY SENSITIVE GOODS: A GLOBAL PERSPECTIVE ?

In this paper I examine whether stringent environmental standards reduce the international competitiveness of environmentally sensitive industries using a comprehensive dataset of trade flows of environmentally sensitive goods (ESGs) disaggregated at the four-digit level of the Standard International Trade Classification. The data relate to the period from 1965 to 1995 and cover 34 countries which accounted for nearly 80 per cent of world exports of ESGs in 1995. The important empirical finding is that export performance of ESGs for most of the countries remained unchanged between the 1960s and 1990s despite the introduction of stringent environmental standards in most developed countries in the 1970s and 1980s. Thus the claim that higher environmental standards reduce the international competitiveness of ESGs can not be justified in the light of available data.

Introduction

Widespread concerns have been expressed recently about the relationship between international competitiveness of environmentally sensitive goods¹ (ESGs hereafter) and environmental regulations.² Does free trade with countries with lower environmental standards lead to a shift of production activity from home countries with higher environmental standards to foreign countries? Will countries with higher standards be forced to lower their standards if capital and jobs also migrate to exploit lower environmental standards abroad (the so-called 'race to the bottom')?³ Is it really the case that countries with lower environmental regulations increase their competitiveness in the production of ESGs? This point receives considerable attention whenever countries are in the process of passing new pollution control measures.

The purpose of this paper is to examine whether the pattern of export performance of ESGs has undergone systematic changes due to the introduction of stringent environmental standards in most developed countries in the 1970s and the 1980s. More precisely, I seek to examine whether countries with high export performance in ESGs in the 1960s shifted to countries with low export performance of ESGs in the 1990s. A comprehensive dataset of trade flows of ESGs disaggregated to the four-digit level of the Standard International Trade Classification (SITC) is employed. The data relate to the period from 1965 to 1995 for 34

reporter countries. These 34 reporter countries include 25 OECD countries and some developing economies in East Asia and accounted for nearly 80 per cent of world exports of ESGs in 1995. I believe that these disaggregated trade data and the coverage of the reporter countries provide a full picture of the changing trade patterns of ESGs. The important empirical finding is that export performance of ESGs for most of the countries remained intact between the 1960s and 1990s, despite the introduction of stringent environmental standards in most developed countries in the 1970s and 1980s.

I first look at the export performance of each ESG for each of the reporter countries in the initial year 1965, the first year in which data are available, then compare it with the performance in the end year, 1995. I found that those countries which exported more than the world average of ESGs (that is a revealed comparative advantage [RCA] index⁴ greater than one) in 1965 achieved the same level of performance in 1995. Looking more closely at the year-to-year path of the RCA index of ESGs, I found that those commodities with either one or two years' high export performance (RCA index greater than one) and those commodities with either 30 or 31 years' high export performance accounted for a large proportion of the exports of ESGs for most of the countries. Time series patterns for the changing export performance of ESGs for some countries that claim to have higher environmental standards did not reveal a significant reduction in exports in the 1970s and the 1980s. The results are quite robust in terms of both the weighted and the unweighted version of this trade pattern. This suggests that the pattern of export performance of ESGs has not undergone systematic changes despite the introduction of stringent environmental standards in most developed countries in the 1970s and 1980s.

The following section briefly reviews the existing literature; the third section discusses the dataset and methodology used in this study. The fourth section reports the results. The fifth section discusses the robustness of the results and the final section presents a conclusion.

Literature

As surveyed by Levinson (1996), the literature on trade and the environment has evolved in two waves. The first wave of research peaked during the late 1970s and seems to have been inspired by the introduction of stringent environmental regulations in developed countries since the early 1970s. The second wave occurred in the 1990s, mainly motivated by the

debate over international trade agreements such as North American Free Trade Agreement (NAFTA) and the Uruguay Round of the General Agreement on Tariffs and Trade (GATT).

The relationship between stringent environmental regulations and international competitiveness⁵ has been addressed in the following ways. The first is the so-called 'race to the bottom' effect.⁶ If free trade occurs between countries with different environmental standards, countries with higher environmental standards will be forced by their domestic interest groups to lower their standards to ensure the survival of their environmentally sensitive industries. Therefore, there will be a tendency towards a 'race to the bottom' when trade among these countries is liberalised. This concern mainly emanates from those countries with higher environmental standards.

The second is the so-called 'pollution haven' hypothesis (Walter and Ugelow 1979; Walter 1982). According to this view, if free trade occurs between countries with different environmental standards, countries with lower environmental standards will tend over time to develop a comparative advantage⁷ in environmentally sensitive industries, resulting in 'havens' for the world's dirty industries (Cropper and Oates 1992).

The third concern is whether increasingly stringent domestic environmental regulations will reduce the international competitiveness of environmentally sensitive industries. In a recent study, Porter and Linde (1995) argue that the relationship between environmental regulations and international competitiveness can be 'complementary' rather than 'mutually exclusive' since 'properly designed environmental standards can trigger innovation that may partially or more than fully offset the costs of complying with them'. However, Palmer, Oates and Porterny (1995) criticise this view and argue that there is always a trade-off between environmental regulations and international competitiveness.

At the heart of all these concerns is the impact of environmental standards on industrial competitiveness. The existing empirical literature provides a mixed picture of the relationship between environmental regulations and industrial competitiveness. For example, Low and Yeats (1992) show that developing countries gained a comparative advantage in ESGs at a greater rate than developed countries. Robinson (1988) found that the abatement content of US imports has risen more rapidly than the abatement content of exports as US environmental standards have grown relatively more stringent than those in the rest of the world. Kalt (1988) shows that domestic environmental regulation appears to have a negative effect on industries' trade performance. All these studies found some evidence suggesting that stringent environmental standards have a negative effect on industrial competitiveness. By contrast, Leonard (1988) found little evidence that pollution

control measures have exerted a systematic effect on international trade and investment by conducting a large case study of trade and foreign investment flows for several key industries and countries.

Tobey (1990) sets up a Heckscher–Ohlin–Vanek (HOV) multi-factor, multi-commodity model. Using 1975 data for 23 countries, Tobey regresses the net exports of five different industries which are classified as pollution intensive on the stocks of productive factors including the environment. The environment variable Tobey uses is the stringency of environmental regulations, varying from 1 to 7, acting as the proxy for the stock of the environment. A country with more stringent regulations is assumed to have a lower environment stock than other countries. He found no evidence that the introduction of environmental control measures has caused trade patterns to deviate from the HOV predictions.

Grossman and Krueger (1991) investigate empirically the environmental impacts of NAFTA. They regress 1987 US imports from Mexico (relative to total US shipments) in 135 industries on factor shares which reflect the factor intensity of each industry. Environmental intensity is approximated by the ratio of pollution abatement costs to total value-added in that US industry. Grossman and Krueger find that the traditional determinants of trade and investment patterns are significant, but that the alleged competitive advantages created by lax pollution controls in Mexico play no substantial role in motivating trade and investment flows.

One shortcoming of the existing literature is that the changing pattern of export performance of ESGs over time is seldom explored. This leads to an incomplete picture of the impact of environmental standards on industrial competitiveness. Low and Yeats (1992) first took up this issue but they put too much emphasis on one particular industry (iron and steel pipes and tubes, SITC 678) and, when looking at the ESG groups, they only look at the overall performance of two groups of countries, namely developed countries and developing countries. As to time horizon, they only look at the beginning (late 1960s) and end years (late 1980s). All this might result in an incomplete picture of the changing pattern of export performance of ESGs over time. Sorsa (1995) also looks at this issue, but at a more aggregated level.

In this paper, I try to avoid the above shortcomings by using a comprehensive dataset and by examining the data from a number of different perspectives. The aim is to provide a full picture of the changing pattern of export performance of ESGs over time.

Data and methodology

This study uses a comprehensive dataset of annual trade flows (exports and imports) of ESGs disaggregated at the four-digit level of the SITC from 1965 to 1995 for 34 reporter countries.⁸ These 34 reporter countries accounted for nearly 80 per cent of world exports (and trade) of ESGs in 1995. They include 25 of the 29 OECD countries⁹ as of May 1997, and major East Asian developing economies. There are 134 ESG commodities at the four-digit level including 'chemical phosphatic fertiliser' (SITC code 5612), 'newsprint paper' (SITC code 6411), 'cement' (SITC code 6612) and 'iron, steel wire products' (SITC code 6731). There are 286,905 observations in total.

As is well known and discussed by Gagnon and Rose (1995),¹⁰ the value of international trade flows has increased substantially in the last 40 years. This is partly a result of inflation, partly a result of real economic growth and partly a result of the increasing importance of trade relative to total output. In particular, a macroeconomic imbalance may result in substantial changes in net exports.

To abstract these effects from our data, the export revealed comparative advantage (XRCA) index is used in this analysis. This XRCA index, introduced by Balassa (1989) in 1965, is defined as a country's share in the exports of a particular commodity divided by the share of that particular commodity in the world exports of manufactured goods, as follows:

$$XRCA_i^k = (X_{iw}^k / X_{iw}^t) / (X_{ww}^k / X_{ww}^t)$$

where $XRCA_i^k$ gives country i 's export-revealed comparative advantage in industry k , X stands for exports, subscript w stands for world, superscript k represents industry k , and superscript t stands for total exports. This index has some limitations. It might not 'reveal' the comparative advantage of a particular commodity, especially when domestic or international distortions are present. However, as discussed in another paper by Balassa in 1987, other indices have their own disadvantages. For example, the net export index used by Balassa (1989) has the practical disadvantage of being affected by the idiosyncrasies of national import protection; in the case of intermediate products, net exports are influenced by demand for the purpose of further transformation in export production. Ballance, Forstner and Murray (1987) discuss the RCA index and find that, while cardinal measures of different RCA indices are highly inconsistent, both ordinal and dichotomous (and especially dichotomous) measures generate consistent results.¹¹ For the purposes of this study, I am interested only in the changing pattern of comparative advantage which can be referred to

dichotomous measures. It is safe to say that the choice of this index serves the purpose of this study.

This XRCA index works reasonably well in terms of the above-mentioned data issue. Since it is an index, the inflation effect can be removed if it is an across-the-board increase in the prices of all commodities. By dividing exports of a particular commodity category by total manufactured exports, this index also takes into account macroeconomic trade balance effects. For instance, a 1 per cent growth in exports spread uniformly across all goods (for example, when domestic savings are greater than domestic investment) will not affect the level of this index. Furthermore, by dividing a country's export sectoral share of a particular commodity category by the same sectoral share in the world exports of manufactured goods, a general increase or decrease in world exports of a particular commodity (growth effect) will not change the level of this index either. This is particularly useful since the share of ESG exports to total exports has declined from 21.7 per cent in 1965 to 16.9 per cent in 1995 (Table 1).

For reasons that will shortly become clear, a normalisation is used for the commodity trade share. This measures the relative importance of a particular commodity trade share in the trade of total ESGs at a particular point in time, as follows:

$$S_{it} = \frac{1}{2} * (X_{it} / X_{et} + M_{it} / M_{et}) * 100$$

where i refers to a particular commodity category within ESGs, t refers to a point in time and e indicates total ESGs. The sum of any time period over all ESGs is 100, and S_{it} is a percentage measure.

Table 1 Exports of ESGs and their importance in world trade: cross-section and time series

	Europe OECD (18 countries)	North America	Oceania	Northeast Asia	Southeast Asia	Other	World
Market shares of total exports by region (%)							
1965	45.1	20.8	2.3	6.7	2.5	22.7	100
1975	43.8	17.0	1.7	9.3	2.5	25.6	100

1985	42.4	17.5	1.6	15.6	3.8	19.1	100
1995	43.7	17.3	1.3	19.4	6.6	11.6	100
Share of ESG exports to total exports (%)							
1965	24.4	20.3	9.2	23.1	18.1	18.8	21.7
1975	24.5	17.2	15.1	23.6	17.8	16.1	20.7
1985	23.5	16.3	17.6	13.4	19.1	22.9	20.3
1995	18.7	16.5	20.2	11.3	11.9	22.6	16.9
Market shares of ESG exports by region (%)							
1965	50.6	19.5	1.0	7.1	2.1	19.7	100
1975	52.0	14.1	1.3	10.6	2.1	19.9	100
1985	49.1	14.1	1.4	10.3	3.6	21.6	100
1995	48.4	16.9	1.6	13.0	4.7	15.5	100

Note: Europe OECD includes 18 of the 22 European OECD countries (Finland, Greece, Ireland, the Netherlands, Poland, Sweden, the United Kingdom, Austria, France, Italy, Belgium, Luxemburg, Portugal, Switzerland, Denmark, Germany, Norway and Spain) but not Hungary, Turkey, Czech Republic and Iceland, as of May 1997. North America refers to the United States, Canada and Mexico. Northeast Asia includes Japan, Korea, Taiwan, China and Hong Kong. Southeast Asia includes Thailand, Malaysia, Philippines, Indonesia and Singapore. Oceania includes Australia, New Zealand and Papua New Guinea.

Source: Calculated on the basis of UN Commodity Trade data from International Economic Data Bank, Australian National University.

This dataset will be analysed from the following four perspectives. Changes in the dichotomous measures of the XRCA index between the beginning and the end period of the sample will be examined first. The aim is to see by what percentage the export flows of ESGs change in 1995 compared with those in 1965 for each of the reporter countries. One would expect commodities with a high export performance at the beginning of the sample period to become less competitive at the end of the sample period if the claim that stringent environmental standards reduce 'international competitiveness' holds.

A second, a more rigorous statistical test of the association between the 1965 series and the 1995 series is performed to determine whether there is any association between export performance of ESGs in the beginning and end years. Although a few tests for association are available, I choose Kendall's tau-b which ranks the XRCA index for each year and calculates the test statistic based on the number of concordant and discordant pairs of observations.¹² Kendall's tau-b is similar to a gamma test but has the advantage that it also

takes into account the tied pairs (that is, pairs of observations that have equal values of X or equal values of Y).¹³

As a third step in this analysis, histograms for each reporter country based on the number of years each reporter country has a 'revealed comparative advantage' (or 'specialisation' with an XRCA greater than 1) are used to look at ESG export performance in the intervening years. Of course, there are two different ways to look at this. The first counts the number of commodities that fall into each of the zero and 31 year frequencies and reports this as a percentage of the total number of commodities. The other takes the normalised trade share of each commodity in a particular year (1990 in this exercise) as the weight and reports this percentage. The latter is generally supposed to convey more information. However, as an alternative way to look at this issue, the former will be discussed in the section on robustness. One might expect that there would be many fluctuations of these histograms indicating that many ESGs have changed their export performance position if environmental standards have significant effects on trade flows of ESGs.

Fourthly, to provide an alternative perspective on the export performance of ESGs in the intervening years, a time series pattern of export performance of ESGs is calculated using as an indicator the percentage trade share of those ESGs which indicated a 'specialisation' in total ESG trade for each year and each country. Since a dichotomous measure can be assigned to each commodity at a particular point in time, the normalised trade share of those commodities (within the ESG group) is summed to provide a percentage share of the normalised trade of all ESG commodities. If the above histogram does not convey sufficient information about the locus of the changing share of one country's competitive ESGs, this time series pattern then offers a unique picture of the export performance of ESGs for a selected country over time.

Results

Table 2 shows the breakdown of dichotomous measures of the XRCA index between the beginning (1965) and the end of the period (1995). This is the weighted version of the breakdown of the XRCA index between 1965 and 1995. 'N' stands for 'non-specialisation' where the XRCA index is less than 1 while 'S' refers to 'specialisation' where the XRCA index is greater than 1. It is a dichotomous measure in the sense that each commodity at a particular point in time is either in the position of 'S' or 'N'. '1965 N' therefore represents

commodities that did not have 'revealed comparative advantages' in 1965 while '1965 S' represents commodities that had 'revealed comparative advantages' in 1965.

Table 2 Breakdown of two-way tables: selected countries

Australia			
	1995 N	1995 S	Total
1965 N	38.1	11.1	49.2
1965 S	10.1	40.7	50.8
Total	48.2	51.9	100

Kendall's tau-b: 0.27
P-value: 0.0001
No. of ESGs:133

Austria			
	1995 N	1995 S	Total
1965 N	20.0	17.1	37.1
1965 S	12.2	50.7	63.0
Total	32.2	67.8	100

Kendall's tau-b: 0.34
P-value: 0.0001
No. of ESGs:133

Belgium-Luxembourg			
	1995 N	1995 S	Total
1965 N	18.8	32.0	50.8
1965 S	6.8	42.4	49.2
Total	25.6	74.4	100

Kendall's tau-b: 0.39
P-value: 0.0001
No. of ESGs:134

Brazil			
	1995 N	1995 S	Total
1965 N	25.8	46.8	72.5
1965 S	1.6	25.9	27.5
Total	27.3	72.7	100

Kendall's tau-b: 0.25
P-value: 0.0001
No. of ESGs:130

Canada			
	1995 N	1995 S	Total
1965 N	31.2	23.3	54.5
1965 S	5.8	39.8	45.6
Total	37.0	63.1	100

Kendall's tau-b: 0.29
P-value: 0.0001
No. of ESGs:125

Chile			
	1995 N	1995 S	Total
1965 N	42.9	12.4	55.4
1965 S	0.0	44.6	44.6
Total	43.0	57.0	100

Kendall's tau-b: 0.27
P-value: 0.0001
No. of ESGs:129

China			
	1995 N	1995 S	Total
1965 N	57.0	8.4	65.4
1965 S	17.4	17.1	34.6
Total	74.4	25.6	100

Kendall's tau-b: 0.15
P-value: 0.01
No. of ESGs: 134

Denmark			
	1995 N	1995 S	Total
1965 N	38.6	19.4	58.0
1965 s	7.5	34.5	42.0
Total	46.1	53.9	100

Kendall's tau-b: 0.40
P-value: 0.0001
No. of ESGs:134

Finland			
	1995 N	1995 S	Total
1965 N	31.2	20.6	51.8
1965 S	2.7	45.6	48.2
Total	33.8	66.2	100

Kendall's tau-b: 0.30
P-value: 0.0001
No. of ESGs:132

France			
	1995 N	1995 S	Total
1965 N	26.7	22.5	49.2
1965 S	19.3	31.5	50.8
Total	46.0	54.0	100

Kendall's tau-b: 0.15
P-value: 0.0128
No. of ESGs:133

Greece			
	1995 N	1995 S	Total

Hong Kong			
	1995 N	1995 S	Total

1965 N	45.1	26.9	72.0
1965 S	7.7	20.4	28.0
Total	52.7	47.3	100

Kendall's tau-b: 0.24

P-value: 0.0002

No. of
ESGs:128

1965 N	59.1	17.9	77.0
1965 S	4.0	17.5	21.5
Total	63.1	35.4	98

Kendall's tau-b: 0.50

P-value: 0.0001

No. of
ESGs:106

Indonesia

	1995 N	1995 S	Total
1965 N	45.5	49.8	95.3
1965 S	1.9	2.8	4.7
Total	47.4	52.6	100

Kendall's tau-b: 0.20

P-value: 0.005

No. of ESGs:128

Ireland

	1995 N	1995 S	Total
1965 N	37.7	46.8	84.5
1965 S	9.1	6.4	15.5
Total	46.8	53.2	100

Kendall's tau-b: 0.21

P-value: 0.002

No. of
ESGs:132

Italy

	1995 N	1995 S	Total
1965 N	41.7	14.6	56.3
1965 S	10.8	32.9	43.7
Total	52.5	47.5	100

Kendall's tau-b: 0.38

P-value: 0.0001

No. of ESGs:134

Japan

	1995 N	1995 S	Total
1965 N	52.4	8.1	60.5
1965 S	17.7	21.8	39.5
Total	70.1	29.9	100

Kendall's tau-b: 0.31

P-value: 0.0001

No. of
ESGs:134

Korea

	1995 N	1995 S	Total
1965 N	40.6	42.1	82.7
1965 S	8.2	9.1	17.3
Total	48.8	51.2	100

Kendall's tau-b: 0.26

P-value: 0.0001

No. of ESGs:133

Malaysia

	1995 N	1995 S	Total
1965 N	56.4	20.6	77.0
1965 S	3.5	19.5	23.0
Total	59.9	40.1	100

Kendall's tau-b: 0.38

P-value: 0.0001

No. of
ESGs:133

Mexico

	1995 N	1995 S	Total
1965 N	46.3	15.8	62.0
1965 S	15.8	22.2	38.0
Total	62.0	38.0	100

Kendall's tau-b: 0.28

P-value: 0.0001

No. of ESGs:134

Netherlands

	1995 N	1995 S	Total
1965 N	22.1	16.4	38.4
1965 S	0.9	60.7	61.6
Total	23.0	77.0	100

Kendall's tau-b: 0.40

P-value: 0.0001

No. of
ESGs:133

New Zealand

	1995 N	1995 S	Total
1965 N	31.2	45.2	76.4
1965 S	0.3	23.3	23.6
Total	31.5	68.5	100

Kendall's tau-b: 0.44

P-value: 0.0001

No. of ESGs:131

Norway

	1995 N	1995 S	Total
1965 N	26.5	15.3	41.8
1965 S	21.2	37.0	58.2
Total	47.7	52.3	100

Kendall's tau-b: 0.23

P-value: 0.0001

No. of
ESGs:131

Philippines

	1995 N	1995 S	Total
1965 N	62.5	23.3	85.8

Poland

	1995 N	1995 S	Total
1965 N	18.6	31.1	49.7

1965 S	10.0	4.3	14.2	1965 S	13.1	37.2	50.3
Total	72.5	27.5	100	Total	31.7	68.3	100
Kendall's tau-b: 0.22				Kendall's tau-b: 0.20			
P-value: 0.0027				P-value: 0.0005			
No. of ESGs:124				No. of ESGs:134			
Portugal							
	1995 N	1995 S	Total		1995 N	1995 S	Total
1965 N	52.5	25.8	78.3	1965 N	60.4	16.8	77.2
1965 S	3.2	18.5	21.7	1965 S	17.8	5.0	22.8
Total	55.7	44.3	100	Total	78.2	21.8	100
Kendall's tau-b: 0.37				Kendall's tau-b: 0.15			
P-value: 0.0001				P-value: 0.0123			
No. of ESGs:133				No. of ESGs:131			
Spain							
	1995 N	1995 S	Total		1995 N	1995 S	Total
1965 N	42.8	40.0	82.8	1965 N	28.4	17.1	45.5
1965 S	7.6	9.6	17.2	1965 S	6.0	48.5	54.5
Total	50.4	49.6	100	Total	34.4	65.6	100
Kendall's tau-b: 0.21				Kendall's tau-b: 0.50			
P-value: 0.0005				P-value: 0.0001			
No. of ESGs:134				No. of ESGs:132			
Switzerland							
	1995 N	1995 S	Total		1995 N	1995 S	Total
1965 N	37.9	21.5	59.3	1965 N	45.9	37.7	83.6
1965 S	0.5	40.2	40.7	1965 S	14.3	2.1	16.4
Total	38.4	61.6	100	Total	60.1	39.9	100
Kendall's tau-b: 0.49				Kendall's tau-b: 0.13			
P-value: 0.0001				P-value: 0.0337			
No. of ESGs:133				No. of ESGs:134			
Thailand							
	1995 N	1995 S	Total		1995 N	1995 S	Total
1965 N	67.9	19.9	87.9	1965 N	42.5	31.6	74.2
1965 S	1.7	10.4	12.1	1965 S	5.3	20.6	25.9
Total	69.6	30.4	100	Total	47.8	52.2	100
Kendall's tau-b: 0.38				Kendall's tau-b: 0.39			
P-value: 0.0001				P-value: 0.0001			
No. of ESGs:131				No. of ESGs:134			
United States							
	1995 N	1995 S	Total		1995 N	1995 S	Total
1965 N	41.4	14.2	55.6	1965 N	27.9	67.7	95.7
1965 S	14.3	30.1	44.4	1965 S	1.8	2.2	4.0
Total	55.8	44.2	100	Total	29.8	69.9	100
Kendall's tau-b: 0.39				Kendall's tau-b: 0.04			
P-value: 0.0001				P-value: 0.58			
No. of ESGs:134				No. of ESGs:130			
Venezuela							

The same logic applies to both '1995 N' and '1995 S'. Since this is the weighted version (using commodity shares in the ESG group in 1990 as the weight) of the XRCA dichotomy, the number in the tables represents the percentage of trade flows rather than the percentage of the number of commodities. These trade flow percentages of ESGs should sum to 100 at any given point in time. The fourth column of each of the two-way tables is the breakdown of the 1965 ESG trade flows while the fourth row of each two-way table is the 1995 breakdown.

For example, in the case of Australia, 49.2 per cent of the normalised trade flows of ESGs were in a position of 'non-specialisation' while 50.8 per cent of the normalised trade flows of ESGs were in a position of 'specialisation' in 1965. Among the 49.2 per cent of the normalised trade flows of ESGs which were in a position of 'non-specialisation' in 1965, 38.1 per cent of the normalised ESG trade flows remain in a position of 'non-specialisation' in 1995 while 11.1 per cent of the normalised ESG trade flows switch to a position of 'specialisation'. The same logic applies to the columnwise explanation.

If the claim that stringent environmental standards hurt those countries with higher environmental standards (mostly developed countries) and benefit those countries with lower environmental standards (mostly developing countries) is to hold, one would expect there to be a significant downturn in the export performance of ESGs across countries, that is the export performance of the ESGs of developing countries would increase while that of developed countries would decrease. One feature that this table reveals strikingly from this table is that trade volumes that move from a 'specialisation' position to a 'non-specialisation' position account for no more than 15 per cent of the ESG trade volumes for the majority of countries except China, France, Japan, Norway and Singapore, with about 20 per cent.¹⁴

Further, if taking into account those trade volumes that move from a position of 'non-specialisation' to a position of 'specialisation', one can see that these trade volumes always exceed trade volumes that move from a 'specialisation' position to a 'non-specialisation' position with the exceptions of Japan, Norway and China.¹⁵ Even in the cases of Japan, Norway and China, this difference is very small, 9.57 per cent, 5.95 per cent and 9.01 per cent, respectively. It becomes clear that the pattern of export performance of ESGs is quite persistent in the sample period. Those commodities which did not display much 'revealed comparative advantage' at the beginning of the sample period tend to remain in a position of 'non-specialisation' while those commodities which did have a 'revealed comparative advantage' at the beginning of the sample period remain in a position of 'specialisation'.

Two exceptions, Brazil and Venezuela, require more attention. The pattern of ESG export performance in these two countries changed dramatically between 1965 and 1995. In Brazil, 72.5 per cent of the normalised trade flows of ESGs were in a position of 'non-specialisation' while 27.5 per cent of the normalised trade flows of ESGs were in a position of 'specialisation' in 1965. In 1995, 72.7 per cent of the normalised trade flows of ESGs were in a position of 'specialisation' while 27.3 per cent of the normalised trade flows of ESGs were in a position of 'non-specialisation'. In the case of Venezuela, 95.7 per cent of the normalised

trade flows of ESGs were in a position of 'non-specialisation' while 4.0 per cent of the normalised trade flows of ESGs were in a position of 'specialisation' in 1965. In 1995, 69.9 per cent of the normalised trade flows of ESGs were in a position of 'specialisation' while only 29.8 per cent of the normalised trade flows of ESGs were in a position of 'non-specialisation'. The downturn in the ESG export performance for some developing countries between the 1960s and the 1990s may be explained by factors like the removal of domestic distortions rather than competitiveness gains due to the loss of competitiveness from developed countries since systematic changes in competitiveness are not evident either in developing countries or developed countries.

Measures of association using Kendall's tau-b test statistic also convey the economic message that there is a strong association between the export performance of ESGs between 1965 and 1995. The p-value shows that the null hypothesis that the two series are distributed independently can be rejected at a significant level of 1 per cent for most of the countries except China (1.02 per cent), France (1.28 per cent), Singapore (1.23 per cent), Taiwan (3.37 per cent), Venezuela (58.1 per cent). This result is presented beneath the two-way tables for each country in Table 2. Note that Kendall's tau-b ranges from -1 to +1 and the nominator is the difference between twice the number of concordances and twice the number of discordances. If this difference is not very large, Kendall's tau-b coefficient can be very low. This does not necessarily mean that the correlation between the two series is weak.

These two-way tables and their statistical tests suggest that those commodities with a high export performance at the beginning of the sample period remain competitive at the end of the sample period for most of the countries.

Figure 1 provides a histogram of years in 'specialisation' for each country. The data are first classified by reporter and commodity. The number of years in 'specialisation' is then counted for each commodity. Since there are 31 years of observations in total, a sub-group that was in 'specialisation' for each of the 31 years then is put to the extreme right of the histogram while a sub-group that was not in 'specialisation' for each of the 31 years then is put to the extreme left of the histogram. These are the weighted versions of the histogram in the sense that it is the normalised trade volume rather than the number of commodities that is put into each cell.

Figure 1 Weighted histograms

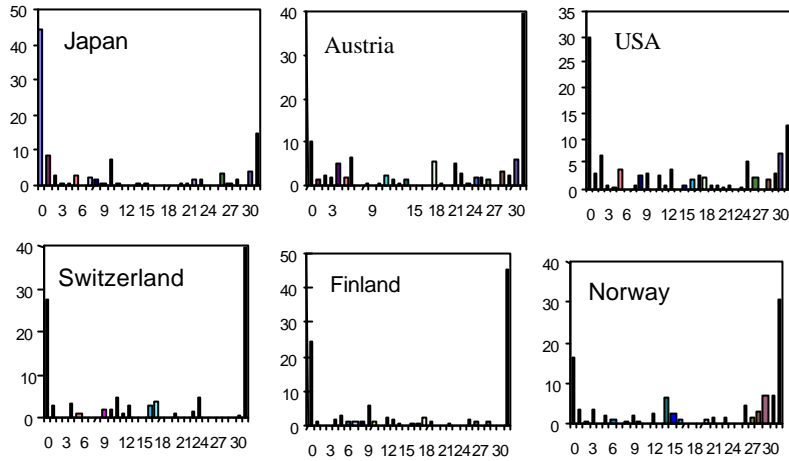
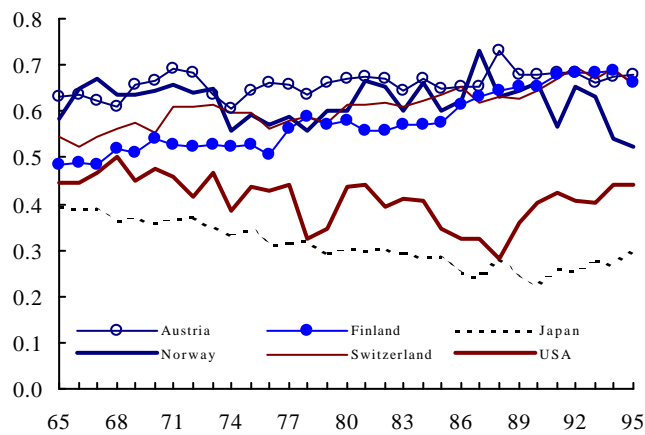


Figure 2 shows the time series pattern of the share of the normalised trade volume of those ESGs with an XRCa greater than 1 as to total ESG trade for some selected countries that claim to have higher environmental standards. This simple figure reveals a more striking result. The share of the normalised trade volume of those ESGs with an XRCa greater than 1 as to total ESGs trade did not decrease over time for most of the countries, except Japan.

Figure 2 Time series pattern of the overall competitiveness of ESGs for selected countries



Source: Calculated on the basis of UN Commodity Trade database from International Economic Databank, The Australian National University.

If stringent environmental standards do have a significant impact on the international competitiveness of ESGs, one would expect that many goods will not be in consistent 'specialisation' or 'non-specialisation'. For most of the countries, one can see a bimodal breakdown of the composition of trade in ESGs, especially for OECD countries, indicating that most trade in ESGs is accounted for by goods in consistent 'specialisation' or 'non-specialisation'. For developing countries, one can see the same results with the exceptions of Brazil, Mexico, the Philippines and Venezuela. Overall, these histograms also reveal that export performance of ESGs for most of the countries are quite persistent. As these histograms do not consider the sequencing of export performance of ESGs, an alternative way to look at the ESG export performance in the intervening years is necessary.¹⁶

If the sample period is then divided into two sub-periods, before and after the end of the 1980s, for Japan and the United States, one can see that after a slow decrease in competitiveness of ESGs in the first period, there was a stark increase in competitiveness of ESGs in the second period. This is an interesting story that requires more theoretical explanation along with an examination of the overall export performance of ESGs over time.

The above analysis suggests that the export performance of ESGs is persistent throughout the sample period despite the introduction of stringent environmental standards by the industrialised countries two decades ago. The claim that higher environmental standards reduce the 'international competitiveness' of ESGs cannot be justified in the light of the available data.

Robustness

The dataset used in this study is comprehensive in the sense that it covers nearly 80 per cent of world exports of ESGs. It is important to test the robustness of the results to determine the extent to which the results are affected by the way we look at these data.

As a check on the robustness of my findings, the data are smoothed using a three-year average in order to reduce the influence of any irregular variations in a particular year. Two period averages, 1965–1967 and 1993–1995, have been chosen as representative of the 1960s and the 1990s. A similar breakdown of the two-way tables is then calculated both for the weighted and the unweighted trade volume of each country. The finding that trade

volumes that move from a position of 'specialisation' to a position of 'non-specialisation' account for no more than 15 per cent of the ESG trade volumes for the majority of countries is even more starkly apparent. France, with 19.3 per cent, previously had a 13.09 per cent downturn in this three-year average version. The maximum percentage downturn is 18.97 per cent (Singapore) in this version compared with 21.20 per cent (for Norway, which recorded 17.09 per cent in the three-year average) in the previous version.

The unweighted two-way tables are calculated as well for each of the countries and the findings remain unchanged.¹⁷ Those commodities that move from a position of 'specialisation' to a position of 'non-specialisation' account for a small proportion of the ESG trade (less than 20 per cent) for the majority of countries.

To check the robustness of results using dichotomous measure, I take an approach suggested by Gagnon and Rose (1995) and Carolan, Singh and Talati (1997). To eliminate small deviations from 1 in the XRCA index, ESGs are classified into categories: (a) those with a value of XRCA greater than one standard deviation above 1, 'specialisation'; (b) those with a value of XRCA within a standard deviation of 1, 'balance'; (c) those with a value of XRCA at least one standard deviation below 1, 'non-specialisation'; where the standard deviation is computed for each commodity's XRCA time series. This categorisation is then applied to the first and last years of the data. Using the normalised trade volume computed earlier as the weight, we obtain the weighted 'standardised' version of the two-way tables.

The result shows that the majority of the ESG commodities that have the status of 'specialisation', 'balance' or 'non-specialisation' in the first year remain in the same position in the last year for all the countries of interest. Those ESGs that switch their position from 'specialisation' in the first year to 'balance' or 'non-specialisation' in the last year again account for no more than 15 per cent of the total ESG trade volume for most of the countries except Japan, Mexico, France and Poland.¹⁸ This result is quite consistent with the result obtained from the simple dichotomous measures of the two-way tables.

Another check on the robustness of this finding is to calculate the unweighted version of histogram of years in 'specialisation' for each country. Instead of the normalised trade volume that corresponds to the cells they belong to in the histogram, the number of commodities is used in the calculation of cell entry. The results also show a bimodality for most of the countries.

One caveat is in order. While the XRCA index can be distorted by domestic or international protection, international protection may be more significant than domestic protection for exports of ESGs. In either case, this distortion would underestimate the XRCA

index especially for developed countries whose average tariff levels are relatively lower than those of developing countries. This will lead to an underestimation of the percentage share of those commodities with a downturn from a position of 'specialisation' to 'non-specialisation'.

But if one looks at the changing pattern of those trade volumes that move from 'non-specialisation' to 'specialisation', these trade volumes always exceed trade volumes that move from 'specialisation' to 'non-specialisation' for the majority of the countries except Japan, Norway and China, as discussed above. This finding can thus be considered to be even more robust.

Conclusion

In this paper, I examine whether the pattern of export performance of environmentally sensitive goods has undergone systematic changes in the period between the 1960s to the 1990s. A comprehensive dataset of trade flows of ESGs disaggregated to the four-digit level of the Standard International Trade Classification from 1965 to 1995 for 34 reporter countries is employed. These 34 reporter countries accounted for nearly 80 per cent of world exports of ESGs in 1995. It is therefore to be expected that this analysis will provide a full picture of the changing performance of ESGs over time. Two different means to break down the two-way tables of export performance of ESGs, using a histogram and time series pattern, have been employed to examine the pattern of export performance of ESGs between the beginning (1965) and end year (1995) as well as in the intervening years.

The important empirical finding is that the export performance of ESGs for most of the countries remained unchanged between the 1960s and the 1990s, despite the introduction of stringent environmental standards in most of the developed countries in the 1970s and the 1980s. This result suggests that the claim that higher environmental standards reduce the 'international competitiveness' of ESGs cannot be justified, at least by the data.

Since the relationship between environmental standards and international competitiveness has been treated as mutually exclusive theoretically (Pething 1975; McGuire 1982; Palmer, Oates and Portney 1995), the persistence of ESG export performance deserves closer theoretical scrutiny.

Notes

This paper is part of my PhD thesis defended at the Australian National University. I am indebted to my supervisors, Peter Drysdale, Kali Kalirajan, Ben Smith and Neil Vousden, for their continuous guidance and advice. I also benefited from the comments and suggestions of seminar participants at the Australian National University. I am grateful for comments by Chandra P. Athukorala. Any errors are my own.

- 1 Environmentally sensitive goods include all four-digit products in SITC 67 (Iron and Steel), SITC 68 (non-ferrous metals) and SITC 69 (metal manufactures n.e.s. [not elsewhere specified]). Also included are all four-digit products in pulp and waste paper (251); organic chemicals (512); inorganic chemicals (513, 514); radiative material (515); coal, petroleum chemicals (521); manufactured fertilizers (561); paper and paperboard (641); paper articles (642); veneers, plywood (631); wood manufactures n.e.s. (632); petroleum products (332); agricultural chemicals (599); and cement (661). These industries incurred pollution abatement and control expenditures of approximately 1 per cent or more of the value of their total sales (1988). The highest expenditure-output ratio in 1988 was just over 3 per cent (cement) and the weighted average for all US industry was 0.54 per cent. See Low and Yeats (1992). Tobey (1990) used a similar definition of environmentally sensitive goods.
- 2 See Anderson and Blackhurst (1992), Dean (1992) and Low and Yeats (1992).
- 3 See Bhagwati and Hudec (1996).
- 4 See section 3 for the definition of the RCA index.
- 5 The concept of 'international competitiveness' in this paper is loosely defined as referring to the industry level. See Warr (1994) for a discussion of this concept.
- 6 For an excellent discussion of this issue, see Bhagwati and Hudec (1996) See also Anderson and Blackhurst (1992).
- 7 See Warr (1994) for a comparison of the concepts 'comparative advantage' and 'competitiveness'.
- 8 The reason I choose to focus on the SITC four-digit level rather than the five-digit level is that data for some commodities stop at the four-digit level without any further disaggregation. The data used in this study are taken from the United Nations trade data base from International Economic Data Bank, the Australian National University.
- 9 Except Hungary, Czech Republic, Turkey and Iceland.
- 10 Gagnon and Rose (1995) used similar methodology to test product cycle theory.
- 11 Ballance, Forstner and Murray (1987) discussed three trade-only RCA indices: (1) $T/XM_{ik} = T_{ik}/(X_{ik} + M_{ik})$; (2) $BAL_{ik} = X_{ik}/E(X_{ik})$; (3) $D-R_{ik} = ((T/XM_{ik}/T/XM_{im}) - 1) * (\text{sign } T_{ik})$, where T is net trade (X - M), XM is total trade, i is the country, k is the commodity and m indicates the summation across all manufactured products. In the BAL index,

$E(X_{ik}) = X_{wk} * (X_{im}/X_{wm})$, where w indicates the summation across all countries, it represents the expected level of exports of the product from the country assuming the country's exports of the product are in proportion to the country's share of world exports of all manufactured products combined. BAL refers to Balassa index (Balassa 1965). D-R index refers to Dongers and Riedel (1977). For T/XM see UNIDO (1982). There are three interpretations of these RCA index. The traditional interpretation of RCA indices is that index quantifies the commodity-specific degree of comparative advantage enjoyed by one country vis à vis any other country. The second interpretation is that these indices provides a commodity-specific ranking of countries by degree of comparative advantage. The third provides a demarcation between countries that enjoy a comparative advantage in a particular commodity and those countries that do not. These three alternatives are referred to as cardinal, ordinal and dichotomous measures, respectively.

- 12 The formula for Kendall's tau-b is as follows:

$\text{tau-b} = (P-Q)/((w_r w_c)^{\frac{1}{2}})$, where $P = \sum_i \sum_j n_{ij} A_{ij}$ (twice the number of concordances), $Q = \sum_i \sum_j n_{ij} D_{ij}$ (twice the number of discordances), $A_{ij} = \sum_{k>i} \sum_{l>j} n_{kl} + (k<i \sum_{l>j} n_{kl})$, $D = \sum_{k>i} \sum_{l>j} n_{kl} + \sum_{k<i} \sum_{l>j} n_{kl}$, $w_r = n^2 - \sum_i n_i^2$ and $w_c = n^2 - \sum_j n_j^2$. See Kendall and Stuart (1979).

- 13 The Spearman correlation test statistic does not take tied pairs into account.
- 14 Mexico is on the margin with 15.75 per cent.
- 15 The United States is on the margin with 14.34 per cent to 14.16 per cent.
- 16 Due to space considerations, only some of the countries are presented here. A full version of these histograms is available on request.
- 17 All the results in this section which are not reported in this paper are available on request.
- 18 If one takes account of those ESGs that switch their position from 'balance' in the beginning year to 'non-specialisation' in the final year, the ESGs that show a decline in their competitiveness still account for less than 15 per cent for the majority of the countries except Japan, Mexico, France, Poland, Norway and China, which have a reduction of around 20 per cent.

References

- Anderson, K. and R. Blackhurst (1992) *The Greening of World Trade Issues*, Ann Arbor: University of Michigan Press.
- Balassa, B. (1987) 'The changing comparative advantage of Japan and the United States', in Bela Balassa, (1989), pp. 81-106.

- (1989) 'Comparative advantage, trade policy and economic development: introduction — an autobiographical essay', in Bela Balassa, *Comparative Advantage, Trade Policy and Economic Development*, New York: New York University Press, pp. xv–xxv.
- Ballance, Robert H., Helmut Forstner and Tracy Murray (1987) 'Consistency Tests of Alternative Measures of Comparative Advantage', *Review of Economics and Statistics* 69(1).
- Baumol, W.J. and W.E. Oates (1988) 'The theory of environmental policy', in S. Bawa and David Bradford, *The Theory of Environmental Policy*, Cambridge; New York and Sydney: Cambridge University Press.
- Bhagwati, J. and R. Hudec (1996) *Fair Trade and Harmonization: Prerequisites for Free Trade?*, Cambridge and London: MIT Press.
- Carolan, T., N. Singh and Cyrus Talati (1997) 'The composition of U.S.–East Asia trade and changing comparative advantage', mimeo, University of California at Santa Cruz.
- Cropper, M.L. and W.E. Oates (1992) 'Environmental economics: a survey', in *Journal of Economic Literature* 30(2), pp. 675–740.
- Dean, J.M. (1992) 'Trade and the Environment: A Survey of the Literature', in P. Low, *International Trade and the Environment*, World Bank Discussion Papers, No. 159, Washington, DC: World Bank, pp. 15–28.
- Donges, J.B. and J.C. Riedel (1977) 'The expansion of manufactured exports in developing countries: an empirical assessment of supply and demand', *Weltwirtschaftliches Archiv* 113, Vol. 1, pp. 58–87.
- Gagnon, J.E. and A.K. Rose (1995) 'Dynamic persistence of industry trade balances: how pervasive is the product cycle', *Oxford Economic Papers* 47(2) pp. 229–48.
- Grossman, G.M. and A.B. Krueger (1991) 'Environmental impacts of a North American Free Trade Agreement', Princeton University and NBER Working Paper.
- Jaffe, A.B., S.R. Peterson et al. (1995) 'Environmental regulation and the competitiveness of US manufacturing: What does the evidence tell us?', *Journal of Economic Literature* 33, March, pp. 132–63.
- Kalt, J. P. (1988) 'The impact of domestic environmental regulatory policies on US international competitiveness' in A. Michael Spence and Heather A. Hazard, *International Competitiveness*, Cambridge, Mass., Harper and Row: pp. 221–62.
- Kendall, M. and S. Alan (1979) *The Advanced Theory of Statistics*, Charles Griffin & Company Limited.
- Leonard, H.J. (1988). *Pollution and the Struggle for the World Product*, Cambridge: Cambridge University Press.
- Levinson, A. (1996) 'Environmental regulations and industry location: international and domestic evidence', in Jadish Bhagwati, Robert E. Hudec, *Fair Trade and Harmonization: Prerequisites for Free Trade? Vol 1*.

- Low, P. and A. Yeats (1992) 'Do "dirty" industries migrate?', in P. Lowe, *International Trade and the Environment*, World Bank Discussion Paper No. 159. Washington, DC: World Bank, pp. 89–103.
- McGuire, M.C. (1982) 'Regulation, factor rewards, and international trade', *Journal of Public Economics* 17(3), pp. 335–54.
- Palmer, K., W.E. Oates and P.R. Portney (1995) 'Tightening environmental standards: the benefit–cost or the no-cost paradigm?', *Journal of Economic Perspectives*, 9(4), pp. 119–32.
- Pethig, R. (1975) 'Pollution, Welfare, and Environmental Policy in the Theory of Comparative Advantage', *Journal of Environmental Economics and Management* 2, pp. 160–69.
- Porter, M.E. and C. van der Linde (1995) 'Towards a new conception of the environment–competitiveness relationship', *Journal of Economic Perspectives* 9(4), pp. 97–118.
- Robinson, H.D. (1988) 'Industrial pollution abatement: the impact on balance of trade', *Canadian Journal of Economics*, 21(1), pp. 187–99.
- Sibert, Horst et al. (1980) *Trade and Environment: A Theoretical Enquiry*, Amsterdam: Elsevier/ North-Holland.
- Sorsa, P. (1995) *Environmental Protectionism, North–South Trade, and the Uruguay*, IMF working paper.
- Tobey, J.A. (1990) 'The Effects of Domestic Environmental Policies on Patterns of World Trade: An Empirical Test', *Kyklos* 43(2), pp. 191–209.
- Trefler, D. (1995) 'The case of the missing trade and other mysteries', *American Economic Review* 85(5), pp. 1029–46.
- Walter, I. (1982) 'Environmentally induced industrial relocation in developing countries', in J.S. Rubin and R. Thomas Graham, *Environment and Trade*, Totowa NJ: Allanheld, Osmun, and Co., pp. 67–101.
- Walter, I. and Judith Ugelow (1979) 'Environmental policies in developing countries', *Ambio* 8(2, 3) pp. 102–209.
- Warr, P.G. (1994) 'Comparative and competitive advantage', *Asian Pacific Economic Literature* 8(2), pp. 1–14
- Unido (United Nations Industrial Development Organisation) (1982) *World Industry in 1980*, chapter 2, New York: United Nations

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