Methodologies for estimating the levels of atmospheric emissions arising from the production of goods imported into the UK

Report of a project undertaken by the Office for National Statistics, United Kingdom

Executive summary

The objective of the project was to test different approaches to the estimation of atmospheric pollution arising from the UK's consumption of products which are imported from and produced in other countries. The three approaches covered are

- To assume that emissions per unit of gross output for overseas industries are on average, for an industrial sector, the same as those for UK industries (Method 1);

- To use other countries' fuel use statistics, in combination with trade and production statistics, to calculate the share of direct carbon dioxide emissions relating to imports from trading partners (Method 2);

- To use other countries' environmental accounts, in conjunction with trade statistics, to calculate the share of atmospheric emissions attributable to the production of imports to the UK (Method 3).

The first method assumes that emission rates overseas are the same as those applying in the UK. If this assumption held true, UK consumption would be directly responsible for about 9 million tonnes of carbon from CO2 emissions in 1990. In addition, indirect CO2 emissions resulting from the production of electricity used in making those imports would, if UK rates applied, total a further 6.4 million tonnes of carbon. An analysis by industrial sector suggests that the direct emissions predominantly relate to production by the chemical, mineral production and iron and steel industries, while the machinery production and chemical industries are largely responsible for the indirect emissions from use of electric power.

One of the weaknesses of this method is that it reveals nothing about the differential impact of producing exports by different trading partners. The second method is potentially more sensitive in this respect, as it relies upon estimates of coal, oil and gas consumption by industrial sector in a range of other countries to calculate the level of direct CO2 emissions in each country. The analysis was carried out using data for 1990 from the COMPASS model developed by Keio University. Although estimates of fuel consumption by broad industrial sector were available for a reasonable number of trading partners, the resulting estimates of CO2 emissions are relatively crude, as they take only approximate account of the different types of fuel

and processes used in manufacturing. Overall, the method seems to account for only about 80% of the CO2 emissions that might be expected. There are also significant gaps and question marks over some of the figures used in the analysis. In theory, the methodology permits a more detailed appreciation of the emissions from particular industries and particular countries, but in practice far more detailed information about both is needed (for example it is not clear why the CO2 emissions intensity of imports of non-ferrous metals from Australia appears to be ten times that of other trading partners) before the results can be treated with confidence.

Another weakness of this method is that it only provides estimates of CO2 emissions. An assessment of emissions of other pollutants would require much more comprehensive information about the fuels used by different processes, as well as about non-fuel based emissions. Where available, such information is commonly used to produce environmental accounts.

The third method overcomes this problem, but it has a much more restricted geographical coverage at present, as it relies upon the availability of a consistent set of environmental accounts for major trading partners. The analysis in this study compared the estimates of direct emissions relating to Danish imports to the UK, using the Danish environmental accounts for 1990, with results from the other two methodologies. The comparison confirmed that fuel-consumption based estimates used in method two understate the levels of CO2 emissions, and broadly confirmed that UK emission rates are similar to those in Denmark. There were still a number of surprising differences, especially for the chemical industry, which will merit further investigation.

A summary of the estimates of direct emissions of CO2 using the three methods is given in the following table. It must be emphasised that the purpose of the analysis was to evaluate the methods of estimating emissions: the results are based upon a high level analysis of the available data, and should not be taken as firm evidence of differential rates of emissions between the two countries concerned.

Illustration of the differences between the methods under consideration

Figures relate to 1990; amounts are CO2 emissions in terms of kilo-tonnes carbon

	Total Danish emissions (based on Danish environmental accounts)	Danish exports to UK as percentage of production (based on data from the COMPASS model)	Emissions re exports to UK assuming UK rates apply (**Method 1**) (based on data from the COMPASS model)	Emissions re exports to UK using energy consumption data **(Method 2)** (based on data from the COMPASS model)	Emissions re exports to UK based on Danish environ-mental accounts (**Method 3**)
Agriculture	740	2.1%	6	8	15
Food production	620	9.4%	41	38	58
Textiles	40	7.2%	5	3	3
Wood products	150	6.0%	0	2	9
Paper, printing	120	1.6%	2	1	2
Chemicals	140	5.2%	63	9	8
Mineral products	540	3.0%	12	13	16
Iron and steel	30	4.2%	11	2	1
Non-ferrous metal products	4	6.0%	1	0	0
Machinery	130	5.5%	13	4	7
Transport equipment	20	6.6%	3	1	1
Total	2,540		157	80	121

Source: Danish Environmental Accounts for 1990, COMPASS model

Note: kTc = kilo tonnes carbon. To obtain amounts in terms of CO2 multiply by 44/12.

As far as pollutants other than CO2 are concerned, the study looked at emissions of sulphur dioxide and nitrogen oxides in Denmark and the UK in 1990. It found that emissions per unit of output for sulphur dioxide and nitrogen oxides were generally lower in Denmark than in the UK, on the basis of the environmental accounts for 1990 for each country.

The study recognised that the production of goods for import into the UK results in emissions not only directly from the manufacturing industries concerned, but also indirectly from the consumption of goods used in the manufacturing process. In theory it would be possible to estimate the extent of these indirect emissions by analysing the structure of each country's economy using input-output tables. In practice the level of detail available for method two, and the lack of consistent input-output data for the countries covered in the study, meant that a full analysis of indirect emissions was not attempted.

Instead, the research focused upon the indirect emissions resulting from the use of electricity in manufacturing industries (the implicit assumption being that if the goods were not produced, there would be less pollution from electricity generation). International differences in the level of these emissions are primarily explained by the structure of the electricity generation industry; for France and Sweden, for

example, emissions are low because of the use of nuclear and hydroelectric power, while in the UK emissions are falling as production switches from coal-powered to gas-powered stations.

In summary, the study has found that use of energy consumption data (method two) does not provide a satisfactory basis for the assessment of air emissions arising from the production of imports to the United Kingdom. The assumption that UK rates of emissions apply is also deficient, in that it takes no account of the different emission intensities applying in other countries.

It follows that the main avenue for further work lies in the development of consistent environmental accounts data for a range of key trading partners, with finer detail on the production, consumption and emissions of particular industries, for a range of years. This would still need to be combined with an understanding of the structure of key industries, the processes used and the nature of the goods produced and exported, in order that variations in the levels of emissions can be explained. It would also be helpful to study the other side of the coin - the levels of emissions relating to exports from the UK in comparison to those in the country receiving the exports.

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