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Towards environmental labelling: offshoring and sustainable development

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Abstract

One common question linked to the environmental concern is whether our development system is sustainable. Our aim in this paper is to analyse the environmental sustainability in terms of CO_2 emissions of a process characterising present modern economies: the growing offshoring of production). This offshoring is usually oriented towards developing countries with lower wages and it generates productivity increases with no need for production to be enclosed in a single location. At the same time this increases the distance merchandises travel until they reach the final consumer and, as a consequence, it raises the volume of CO_2 emissions. Is this rise linked to offshoring really important? Could it be socially desirable to include its mileage in a product label?

As far as we are aware this is the first attempt to measure pollution due to offshoring. We use offshoring data measured as total imported inputs for the Spanish economy in 1995 and 2000 using input-output tables (INE), and combine that information with data for origin of imports from the Dirección General de Aduanas database, and data on carbon emissions from the Satellite atmospheric emissions accounts (INE).

Keywords: Offshoring, carbon emissions, input-output, total import content of exports.

1. Introduction

The fast progress in information and communication technologies and the reduction in tariffs have contributed to an important increase in international trade. Furthermore, they have been a factor in the increasing fragmentation of production processes, so firms outsource internationally their production as a way to compete in a globalised world and this increase in international trade is not only of final goods but also of intermediate commodities. All this implies that countries are increasingly becoming part of global supply chains where different activities and tasks necessary for a particular manufacture are implemented in different locations. This process is commonly called outsourcing or offshoring in the literature[1] and allows for increases in productivity with no need for production to be enclosed in a single location, as it is pointed out by Grossman and Rossi-Hansberg (2006).

But in addition to all of this, the offshoring have two consequences in relation to the environment: first, it implies an increase in the distance merchandises travel until they reach the final consumer and, as a result, it raises the volume of CO_2 emissions and, second, it involves that consumers and pollutants emitted in the process of production of consumption goods can be separated. For example, as an illustration of the first, home-grown Britannic products are being transported thousands of miles overseas for processing before being put on sale back in Britain. Concretely, Scottish prawns are being hand-shelled in China, Atlantic haddock caught off Scotland is being prepared in Poland and Welsh cockles are being sent to Holland to be put in jars before going on sale back in Britain[2]. And it is easier to found or to think of other examples with not only primary but also industrial goods[3].

About the second consequence, the separation between consumers and the locations where pollution takes place, it is important because international trade affects national CO_2 emissions and can influence in the country's capability to meet its objectives in terms of pollution, as a significant amount of CO_2 is incorporated in the

[1] See Egger and Egger (2005), Grossman and Rossi-Hansberg (2006), Cadarso, Gómez, López and Tobarra (2008).
[2] These examples are extracted from an article in The Sunday Times, on May 20th, 2007.
[3] Parts and components of vehicles, computers and so on.

products that are internationally traded. Exports, if they are products intensive in CO2 emissions, can put a "load" on the country while importing products intensive in carbon emissions could take a "load" off that country[4]. Commonly, national emissions of pollutants are accounted using the principle of territorial or production accounting principle (IEA, 2001, Kyoto Protocol). That is, a country is responsible for pollutant emissions from the domestic process of production of energy, goods and services regardless where these commodities are going to be consumed (at the domestic market or they are exported). This is called also the producer responsibility. But this standpoint can provide some problems as the previous mentioned about the pollutant intensity of exports and imports. This concern has culminated in the analysis of different indicators as (total) emissions embodied in trade, (total) emissions embodied in exports and imports and the balance of emissions embodied in trade as de difference between the two last. The final aim is to achieve the consumption accounting principle or consumer responsibility that determines a country's responsibility linked to its consumption.

The concept of consumer responsibility was introduced by Proops *et al.* (1993) and Munksgaard and Pedersen (2001) and since then applied by others, like Ahmad and Wyckoff (2003), Lenzen *et al.* (2004), Peters and Hertwich (2006) both using a multi-region input-output model, and for the Spanish case, Sánchez-Chóliz and Duarte (2004) and Serrano and Roca (2007).

Our paper goes on with the concern about the impact of international trade in the environment and the standpoint of the consumer responsibility, but pointing out the relevance of the process of increasing imports involved in offshoring or defragmentation of production. Not only because a country can gain if the pollution content of its imports is larger than that of its exports (Antweiler, 1996, Muradian *et al.*, 2002) or because along with international trade a country can transfer the cost of polluting in production to other countries and these can have more pollutant technologies or weak environmental legislation (Peters and Hertwich, 2008). But also because, along with the increase of imports, there is an increase in transport of commodities and, as a result, an increase in CO_2 emissions.

[4] Some examples of the importance of this fact are provided by Lenzen *et al.* (2004), with Denmark, and Peters and Hertwich (2006), with Noway.

The analysis that follows focus on CO_2 emissions because it is by far the largest of the greenhouse gases by volume, representing about 80% of the total emissions of them[5] and because it is the main pollutant involved in the combustion of fossil fuels.

Production is conditioned and determined by consumption patterns and, because of this fact, consumers have the opportunity of guiding the economic system playing a key role in deciding between alternative production processes (Muradian *et al.*, 2002). So, consumers demanding a certain environmental quality of products may induce a particular kind of development. For doing this consumers must know how "clean" is the production process of a commodity but also, since our point of view, if the commodity has travelled around the world and what does this travel mean in terms of pollution.

2. Methodology

2.1 Input-output models and emissions multiplier

The quantity system in input-output models can be represented as:

$$\begin{aligned} x^T &= x^d + x^m \\ x^d &= A^d x^d + y^d \\ x^m &= A^m x^d + y^m \end{aligned} \quad \textbf{(1)}$$

where x^T denotes total production, x^d domestic production and x^m total imports, including intermediate and final goods. A^d is the matrix of domestic production coefficients and A^m is the imported one, y^m corresponds to final demand covered by domestic production and, finally, y^d denotes imports going to final demand. Rearranging the previous expression:

$$\begin{aligned} x^d &= \left(I - A^d\right)^{-1} y^d \\ x^m &= A^m \left(I - A^d\right)^{-1} y^d + y^m \end{aligned} \quad \textbf{(2)}$$

[5] Ahmad and Wyckoff (2003).

We now combine the input-output scheme with the information about emissions. First we consider the information about pollution linked to production already available. From Spanish satellite accounts (INE) we can obtain direct atmospheric emissions of pollutants per monetary unit of output:

$$e = E < x^d >^{-1} \quad \textbf{(3)}$$

From the previous expression it is possible to measure total atmospheric emissions re-organized by vertically integrated sectors:

$$E = < e > (I - A^d)^{-1} y^d = \varepsilon \, y^d \quad \textbf{(4)}$$

where $\varepsilon = < e > (I - A^d)^{-1}$ is the emissions multiplier, that measures direct and indirect emissions per unit of final demand. We can calculate how total emissions are distributed among final demand by developing expression (4) further:

$$E = < e > (I - A^d)^{-1}(y^r + y^x) = \varepsilon \, y^r + \varepsilon \, y^x \quad \textbf{(5)}$$

where two elements are considered within final demand, y^x is exports and y^r is the addition of private consumption, public consumption and investment (as rest of total demand). Expression (4) shows the emissions associated to domestic production and expression (5) distinguish total emissions embodied within exports and within the rest of final demand (private and public final consumption and investment). Diagonalising the final demand vectors and summing up the matrix obtained by columns, we account for total emissions embodied in final demand by vertically integrated sectors.

The emissions directly embodied in imports (intermediate and final) can be obtained by:

$$Edirect_c^m = < e_c > [A_c^m \left(I - A^d\right)^{-1} y^d + y_c^m] \quad \textbf{(6)}$$

We now adapt expression (5) in order to obtain the total (direct and indirect) amount of emissions associated to imports as commodities produced in other country c:

$$\mathrm{E}_c^m = < e_c > (I - A_c^d)^{-1}[\mathrm{A}_c^m \left(\mathrm{I} - \mathrm{A}^d\right)^{-1} \mathrm{y}^d + \mathrm{y}_c^m] = \varepsilon_c [A_c^m (I - A^d)^{-1} y^d] + \varepsilon_c y_c^m \quad \textbf{(7)}$$

To calculate the previous measure it is necessary to know the emissions per monetary unit of output by country of origin of imports (the exporting country) e_c, the matrix of imported inputs from country c, A_c^m, the final demand directly purchased from country c, y_c^m, and, finally, the coefficient matrix of country c, $A^d{}_c$. Data availability problems compel us to assume, in expression (7) empirical calculation, that in expression (6) the countries have the same polluting technology, so that e_c can be substitute by e and $A^d{}_c$ by A^d, simplifying the previous expression[6].

Our analysis is based on the awareness that, in order to measure the responsibility of a country in terms atmospheric emissions, it is necessary account to distinguish between the point of view of domestic production and that of consumption. The first measures the emissions embodied within the domestic production as obtained from equation (5). The second considers that a country is also responsible for atmospheric pollutants emitted by other countries during the process of production of both, imported intermediate inputs used for domestic production and imported final goods. This is measured from equation (7). Also, from this second point of view, emissions embodied in exports should be assigned to the country of destination.

2.2 Pollution linked to goods international trade

Production fragmentation in different tasks, and the location of those whereas the lowest cost is found, has important implications on the amount of transport linked to final goods production. The growth in the transport requirements per unit of final inputs implies a significant increase in pollution related to production.

In this section, we aim to calculate CO_2 emissions linked to imports transport depending on the distance covered, the transport means chosen and the number of transported tons. To control for these specifications we add two new scripts to our notation, subscript c that accounts for the country or area of origin (where 23 different geographical areas are considered for the empirical analysis as explained in the following section), and superscript t accounts for the means of transport (including four main groups, by sea, rail, road or air, and the remaining on a fifth group).

[6] This is a restricting assumption because it is expected that different countries have different technologies and as a result different amounts of emissions embodied in production. Nevertheless this assumption is often used in literature (Munksgaard and Pedersen, 2001, Roca and Serrano, 2007). Even when it is used a more appropriate model as an MRIO (Multiregional Input-Ouput model) in some cases several assumptions to limit the huge need of information are done, as in Peters and Hertwich, 2006).

We use input-output methodology and the concept of vertically integrated sectors to account not only direct emissions but also indirect emissions associated to the production process[7] and to the transport of imported inputs. This last feature is one of the main contributions of the paper. We propose a new methodology that permits the inclusion of emissions linked to international transport in the total emissions of a country, following the consumer principle.

In order to calculate CO_2 linked to a given merchandise, independently of whether it is a final or an intermediate one, it is necessary to know the distance covered by the good, the chosen means of transport and the CO_2 per kilometre-ton emissions related to the means. In order to account for the CO_2 emissions linked to imports coming from country *c*, using means of transport *t*, the following expression can be built:

$$\mathrm{E}_{\mathrm{c}}^{\mathrm{t}} = Km_c \otimes E^t \quad \textbf{(8)}$$

where Km_c is a vector that measures the kilometrical distance between *c*, country of origin of inputs, and the importing country by means of transport, and E^t is a *1xt* vector that includes CO_2 emissions that are the result of a ton of input covering a kilometre by a given transport means *t* (this vector does not depend on the country). It is possible to calculate an $\mathrm{E}^{\mathrm{t}}_{\mathrm{c}}$ vector as a number by number product of those two vectors. There would be one vector for each country or geographical area and the emissions will be higher the more distance the good has to cover between origin and destination.

The expression used to calculate CO_2 emissions linked to country *c* imports of good *i* is:

$$\mathrm{Etrans}_{\mathrm{c}}^{\mathrm{mt}} = \mathrm{Z}_{\mathrm{c}}^{\mathrm{mt}} < E_c^t > \quad \textbf{(9)}$$

where $Etrans_c^{mt}$ is a *nxt* matrix; Z_c^{mt} is a *nxt*; matrix that measures the imported tons of good *i* coming from country *c* by means of transport *t* (each geographical area will have its own matrix) and <> means that it is a diagonalised vector. In the following section we develop the information and calculations required by the previous

[7] Most of the papers cited use input-output methodology.

expression, that mainly use data from the Dirección General de Aduanas (National Customs Agency, DGA from now onwards).

2.3 Pollution linked to transport of imported inputs and final goods

Once we know the amount of pollution linked to total imports of good *i* coming from a given country through each means of transport, we move to the calculation of the pollution lined to intermediate and final goods transport, by combining information from the DGA with input-output tables. In order to do so, we first obtain the pollution vector linked to imports from a specific country, by adding by columns the $Etrans_c^{mt}$ matrix:

$$Etrans_c^m = \sum_{t=1}^{4} Etrans_c^{mt} \qquad \textbf{(10)}$$

In the next step, $Etrans_c^m$ vector is decomposed in a *nxn* matrix called, where each element indicates the pollution lined to the transport of imports coming from country *c* that industry *j* makes of each product *i* as an intermediate input. In order to do so, total imports of each input *i* are distributed depending on the share that each industry *j* imports of the specific input on the total imports (intermediate and finals). This information is discussable by combining the input-output table, that allows us to differentiate among inputs and final products, and the DGA statistics, that provides information about total imports by country and by product, however it does not distinguish between intermediate and final goods. This procedure leads us to assume that a good *i* transport pollutes similarly independently of whether it is going to be used as a final or intermediate good[8].

Finally, we can express the pollution linked to transport of imports of product *i* from country *c* per unit produced by industry *j*, as each element from the following $\ddot{e}_c^m$ matrix:

[8] The distribution of imports among country of origin between intermediate and final goods according to TIO presents a problem since we apply the same share of imports to all goods. This assumption is not necessarily correct, and it is more difficult to meet at a low disaggregation level, as we use, only 25 industrial sectors. It is arguable that the final-intermediate goods distribution for the Office Machinery and Computers sector is the same for China and Germany. However, we use a different distribution according to the product.

$$\ddot{e}trans_c^m = \ddot{E}trans_c^m < x^d >^{-1} \quad \textbf{(11)}$$

The equivalent expression for the total of the economy is simply the sum of the emissions linked to the transport from each country and we can represent it by the following:

$$\ddot{e}trans^m = \sum_{c=1}^{8} \ddot{e}trans_c^m \quad \textbf{(12)}$$

We can also find the pollution linked to transport of final goods imports from country *c* ($\ddot{E}trans_c^{my}$), by multiplying vector $Etrans_c^m$ by the share of final imports of good *i* on total imports, intermediate and final, of that product *i*.

2.4 Pollution linked to international transport of imported inputs and final goods

Once we have distributed the direct emissions linked to international transport of imported inputs, we can get the total (direct and indirect) emissions linked to transport of imported product per unit of final demand ($\ddot{e}transtotal^m$). We can then obtain a multiplier of emissions linked to the international transport of goods. This way we assign the responsibility of pollution included in the international transport of products to their consumers (national or foreign through exports) and not to the importing-producing industries. The expression would be as follows:

$$\ddot{e}transtotal^m = \ddot{e}trans^m \left(I - A^d\right)^{-1} \quad \textbf{(133)}$$

This measure of pollution linked to inputs transport only allows us to calculate pollution generated in the input last round, that is to say, in the last trip to reach the country of study. However, we are not taking into account all the pollution generated in the transport of inputs manufactured in several countries (international production networks). In order to calculate this pollution we would need to link the available information in the input-output tables of all countries participating in the production of inputs incorporated in a final good.

Finally, the total amount of pollution related to the required imported products to satisfy the total of final demand would be given by the following vector *nx1*:

$$\ddot{E}\mathrm{transtotal}^{m} = \ddot{e}\mathrm{trans}^{m}\left(I - A^{d}\right)^{-1} y^{d} + \ddot{E}trans^{my} \quad \textbf{(144)}$$

2.5 Total pollution linked to production and transport in a country

Adding by rows $E + E^{m} + \ddot{E}transtotal^{m}$ we get the total pollution linked to the domestic and imported production and the domestic and international transport required for the final demand in each industry. We can then analyse the importance of the growing offshoring of activities on the evolution of pollution.

3. Data and results for CO_2 emissions from transport of Spanish imports

3.1 Data

In order to construct the vectors and matrices described in the previous section, we have used data from several sources, as described below.

The information about $Etrans_{c}^{mt}$ matrix in (8) comes from DGA since this organization offers data that allow to distinguish between imports in tons and euros for each product, classified both by country of origin and means of transport. To be precise, it provides information on weight, value, country of origin, type of transport and taric code of product. However this source does not discriminate whether goods are intermediate or final ones.

As the input-output tables have a different classification, following NACE, we have first reclassified the data on imports. After that we have aggregated the data in terms of countries and means of transportation. We distinguish the EU-15 countries one by one, the rest of EU countries together[9], Turkey and the rest of EU candidates (Croatia and Former Yugoslav Republic of Macedonia), the rest of European countries, a group of rapidly growing Asian countries (China, India, Thailand and South Korea), the rest of Asian countries, America, Africa and Oceania. As for the type of transport, we classify the available information into maritime, rail, road, air and other modes of transport (post, self-propelled, fixed transport system, and unknown).

[9] In order to guarantee comparison with more recent data, we have included the 12 new EU countries in this category for 1995 and 2000.

The data on tons of imported products have to be combined with information on distances to calculate the measure of ton-Km (one ton of cargo carried one kilometer). Km_c accounts for the kilometrical distance between the input origin country and the importing one. The distance for rail, road and air transport are approximated by kilometer distances between Madrid and the capital city of each corresponding country, with the only exception of Turkey where Istambul has been preferred, since the capital is not the production main axis and is more centred. The distance for maritime transport is the kilometer equivalent of the nautical miles between Valencia and the main national sea port for each of the considered countries (or the closest important sea port in the case of inland countries).

Finally, we need information on CO_2 emissions per ton-Km for each type of transport in order to calculate total emissions, by including it in E^t. Using data from the Network for Transport and the Environment, we have assumed CO_2 emissions per ton-Km of 18 grams for maritime transport, 17 for rail, 50 for road, 540 for air and 25 for other modes.

3.2 CO_2 emissions from transport of Spanish imports

The results for emissions according to products show agriculture, extractive products and oil in total emissions as the most important polluters, followed from a distance by metallurgy and chemical products. These are all major raw materials and products coming from all over the world. It is also important to note the increase between 1995 and 2000 in almost all sectors. This rise is particularly distinct in oil and gas, coming mainly from a great distance (Middle East, Mexico, Venezuela, Russia, South Africa, Algeria and Libya) and increasing considerably in amount. In terms of percentage increase it is also noticeable the increase in sectors that represent a much smaller share of total emissions, like electrical machinery (210.1%), machinery and equipment (208.2%), electronic components (157.8%) or motor vehicles (150.4%). These are sectors where the offshoring process has been particularly intense in recent years, raising both the amount of trade and the extent of countries included in the links among different stages of production located in several countries.

Figure 1

Looking at the pollution by country of origin of imports, trade from America was the biggest producer of emissions in 1995, followed closely by imports from all Europe put together and Asia was a distant third. The strong trade integration of Spain within the EU accounts for an important share of the emissions from imports, around one quarter of total pollution.

Figure 2

Nevertheless, when we compare the distribution for 1995 and 2000 we notice some important changes. While the pollution share of imports from EU countries is stable, America decreases drastically and the group of China, India, Thailand and Korea, rest of Asia and rest of Europe increase considerably. Europe as a whole becomes the main contributor to transport pollution as origin of imports, with America and Asia following closely. This reflects the changes in providers of intermediate and final products that have affected Spain as well as the rest of the world. Asia is increasingly becoming a major source of trade and together with its distance to Spain explains the increase in its contribution to CO_2 emissions from transport.

Figure 3

It is not a surprise that the most important pollution generator is maritime transport. While its emissions per ton-Km are reduced compared to road and air transport, most cargo is carried by container shipping and especially when it comes from countries across the globe. The increase between 1995 and 2000 in the amount of CO_2 emissions from maritime transport is remarkable and reflects both the rise in trade and the change in sourcing from America towards Asia in particular. Looking at the disaggregated data, the emissions of importing by sea from Asia doubled between 1995 and 2000 (from 636 to 1303 Gg for China, India, Thailand and Korea and from 1006 to 1761 Gg for the rest of Asia). While the increase in pollution from sea shipping is the main element to note in level terms, the percentage rise from transport by lorry is even higher (68.8% versus 31.4%), due to the increase in trade with European countries.

Figure 4

4. Offshoring, transport and CO_2 emissions

In this section we apply the methodology discussed in section 2 and discuss the results. The calculation of matrixes explained in section to measure the pollution linked to the transport of goods, however we will focus on the importance of pollution linked to the transport of intermediate goods, since it is directly linked to the spread of offshoring. We first discuss the evolution of direct pollution linked to offshoring and then go to discuss the evolution of total pollution linked to offshoring, as the sum of direct and indirect.

The following figure shows the distribution of pollution among the different activities that produce it. It is possible to see how the domestic production is responsible for most of the pollution for both years, however its share has been reduced in favour of the percentage of pollution due to use of imports, either because of the increase in pollution generated in the production of imports of inputs and final goods, or because of the increase of pollution due to the transportation of imports. On their own previous values, the highest growth is due to the production of imported final goods, 24% (not in figure), very closely followed by the increase in the transportation of imported intermediate inputs that is a 15% higher in 2000 than in 1995.

Figure 5

So the importance of offshoring as a strategy to reduce firms cost allowing to increase competitiveness is so because the pollution costs related to offshoring are not incorporated in the final cost of goods. This is generating the general belief that the increase in global emissions has not effect on the firms and countries generating this problem. As an example for Spain, as shown in the following figure the increase in total pollution linked to production and consumption grows over 19% between 1995 and 2000, from around 250000 gigagrams to close to 300000

Figure 6

The increase is mainly due to a few sectors, where offshoring has become prevalent as a production strategy. The importance of pollution linked to offshoring is shown in the next two graphs. First we see that the higher weight in pollution linked to offshoring is found in those sectors where the importance of natural resources, not available in Spain, is high. However these are not the sectors where the pollution linked to international trade is growing the most. This figure does not include four sectors because their CO2 emissions are negligible, these are: Energy and water, Tobacco, Clothing and furs, Editing and publishing.

Figure 7

The sectors where pollution linked to international trade is growing the most are those where the characteristics of markets and production technologies allow for production to be divided in task and distributed along different geographical areas to take advantage on differential in labour cost mainly, although other reasons are also possible.

Figure 8

When we account for the growth of CO_2 emissions associated to the transport of Spanish imports, as shown in the following figure, we observe that the rate of growth of these emissions by sector is larger on the sectors that are leading the process of offshoring at international level (Feenstra and Hanson, 1996, Campa and Goldberg, 1997, and Falk and Wolfmayr, 2005), that are the same as in Spain (Gómez, López and Tobarra, 2006). These sectors are those related with knowledge and information technologies, as machinery and mechanic equipment, electric machinery, instruments, optician and watches, electronic components, also motor vehicles or some traditional industries as furniture (that includes toys), wood and cork and textile industries. All the sectors cited are in figure 8.

About the total pollution linked to transport, that includes both direct and indirect ones, the distribution of the absolute value per sectors changes. When the total pollution is accounted for the emissions are linked to the final demand sector, instead of the productive sector, this is so because those sectors that pollute to produce intermediate inputs for other sectors have their emissions spread on the inputs user sectors. The main changes are in service sectors and also some manufacturing sectors have different pollution measures associated. In the following figure, compared to the direct absolute value one, we observe how the value of pollution is reduced for the Petrol industries, since a high proportion of its production is used by other sectors instead of going to final demand. The rest of 'natural resources' industries also reduce a lot their associated pollution, while the final goods ones appear as main polluters.

Figure 9

The following figure shows the total emissions linked to offshoring in services sectors. These sectors did not pollute at all directly, however they use goods produced by direct polluters. The amount of pollution associated to this sectors would lead them to the forth position among the highest polluters, and, in general, it is growing for the analysed period.

Figure 10

5. Conclusions

In this paper we have tried a first approximate to measuring CO_2 emissions related to the offshoring process. We have first explained the methodology that combines data on imports (by country of origin, means of transportation and type of product), with information from the input-output tables that indicates the amount of imported inputs from each product required per unit of production in each industry, the satellite accounts on CO_2 emissions that provide information of pollution related to production and national transport, and some parameters like the kilometre distance from the exporting country and the emissions per ton-Km, by type of transport.

We apply this methodology to data for the Spanish economy in 1995 and 2000. The increase in trade and the changes in the sources of some products, mainly from American towards China, other Asian countries and some European countries, explain the rising CO_2 emissions related to the international transport of imports. By using the offshoring measure (imported inputs) from the input-output tables, we try to identify the share of that pollution linked to the fragmentation of production in different countries. As expected the industries where this offshoring process is more intense show the greatest increases in carbon emissions related to international transport.

The reduction in transport costs experienced in recent times has increased trade and has made accessible locations on the far side of the world. Prices have been reduced and the variety of goods is almost never-ending. However these costs do not reflect CO_2 emissions so consumers can not appreciate this downside, generating an excess demand for some goods. Only if those emissions were included as costs and therefore affect prices, or if producers were legally bound to indicate the different processes involved in bringing the product to the consumer, could this negative externality be, at least partially, internalised.

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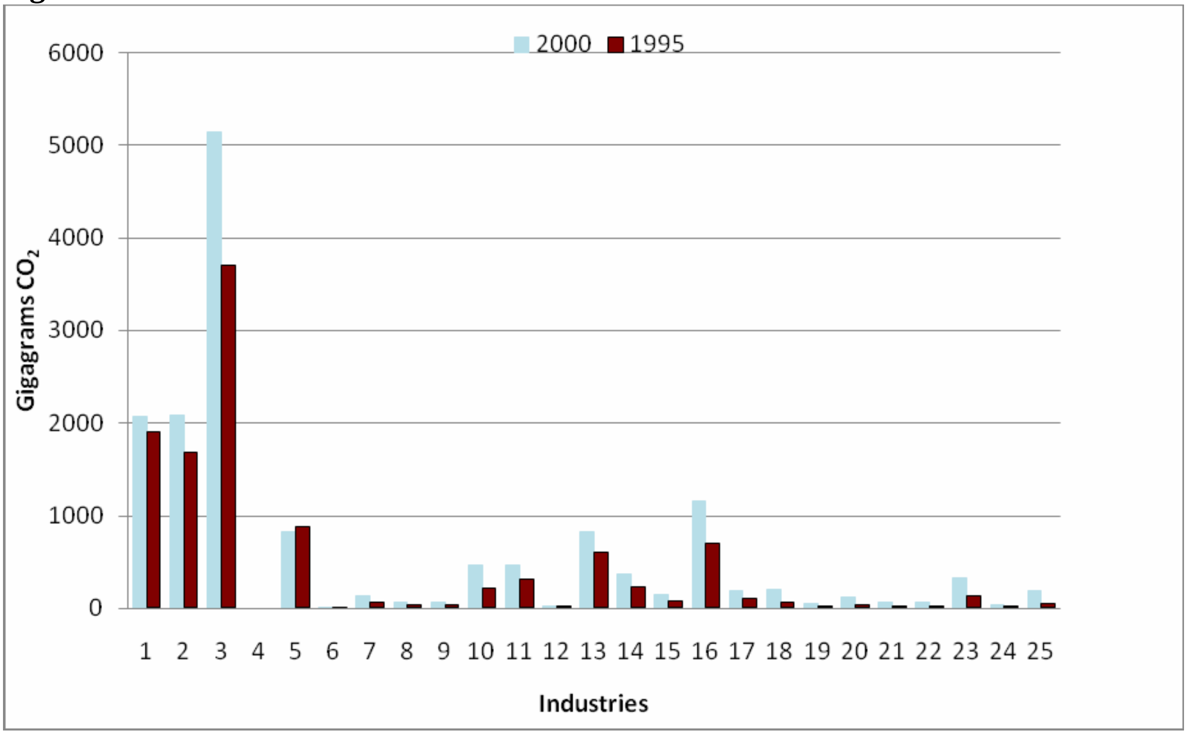
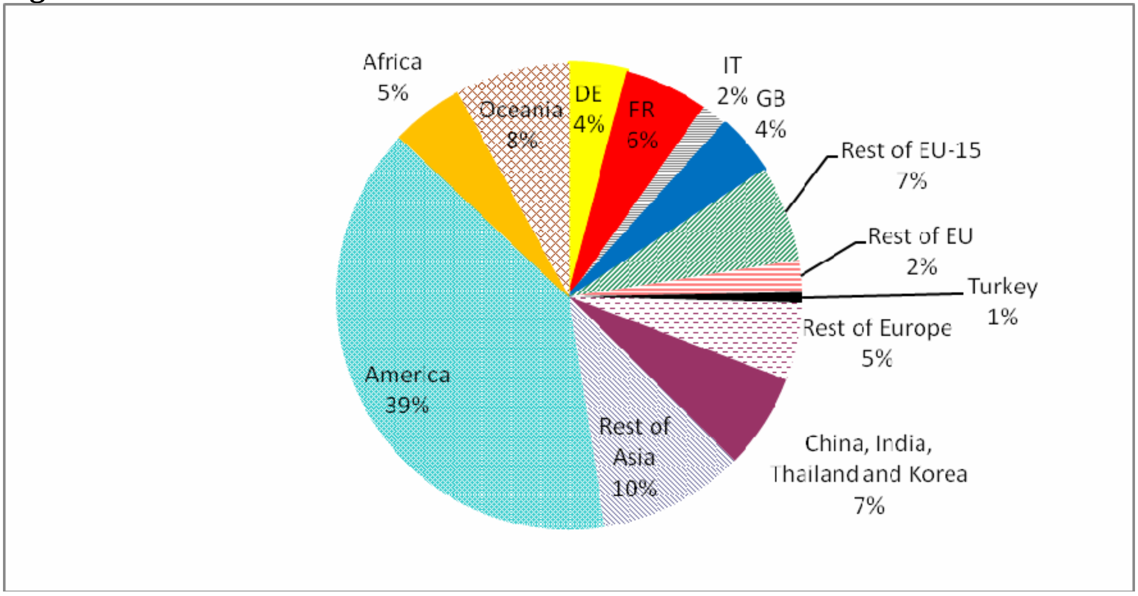
Figures:

Figure 1



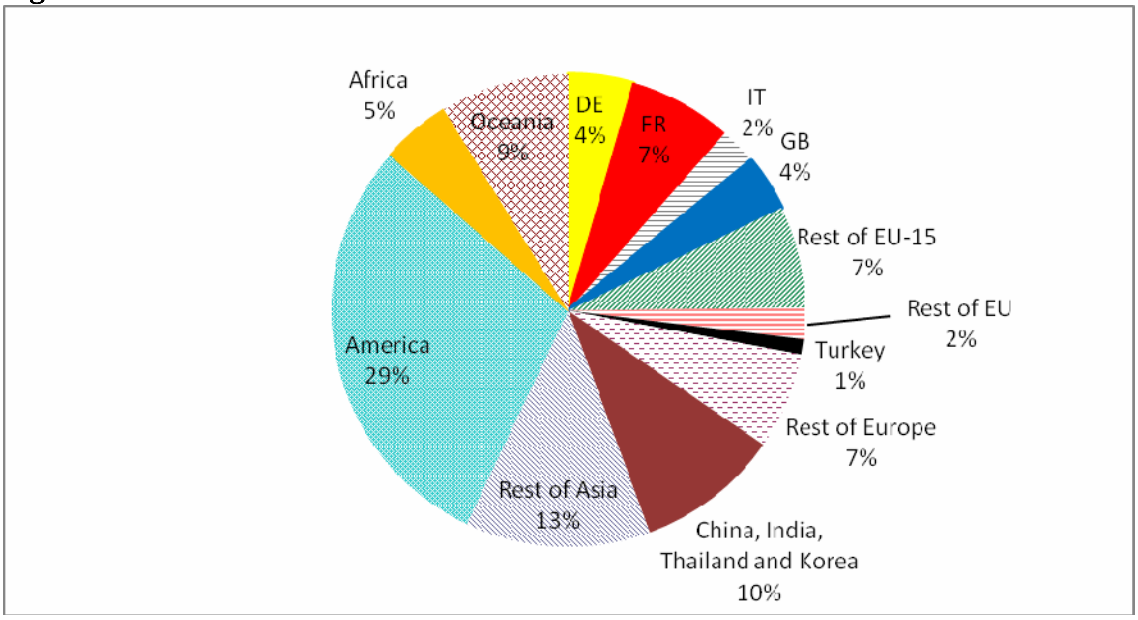
CO_2 emissions from the transport of imports according to the type of product, 1995 and 2000

Figure 2



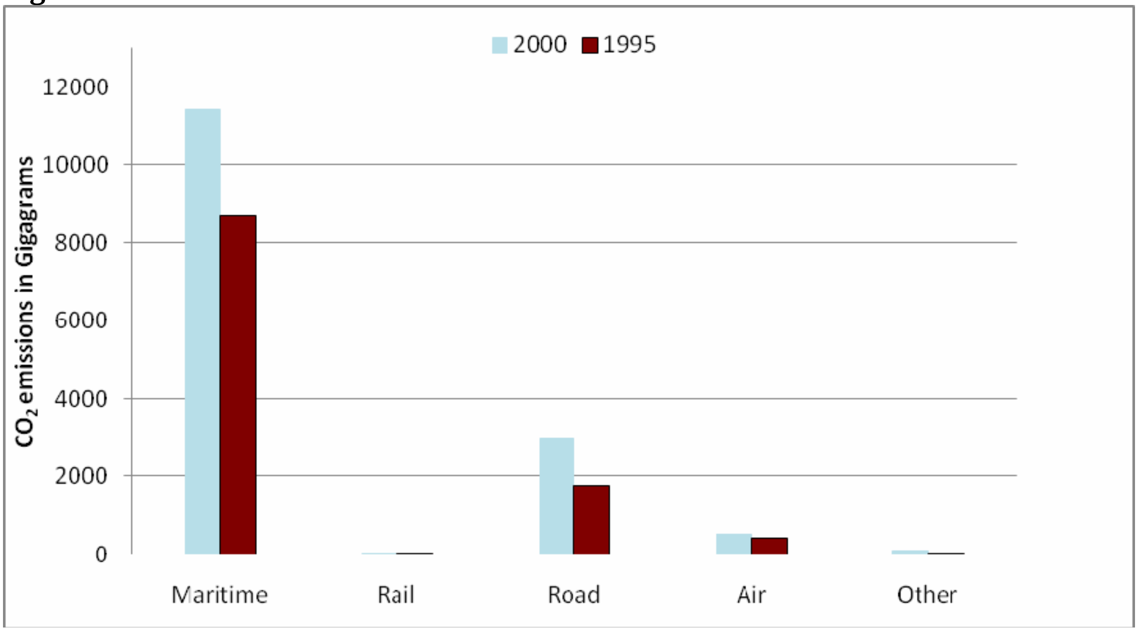
Country distribution of CO_2 emissions from the transport of Spanish imports, 1995

Figure 3



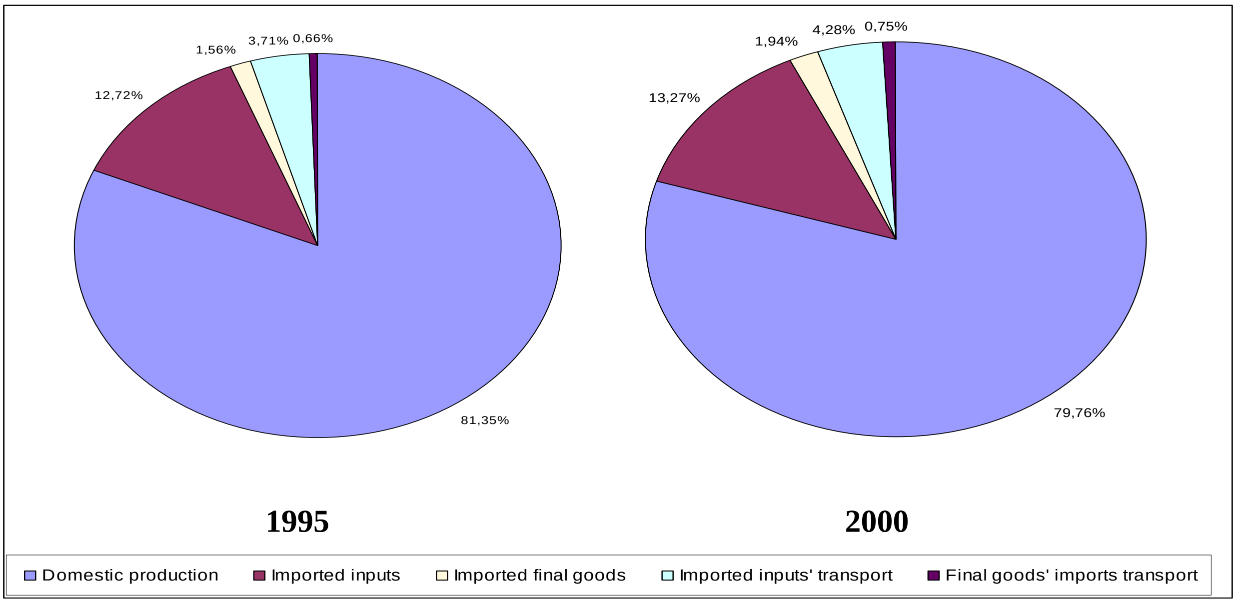
Country distribution of CO_2 emissions from the transport of Spanish imports, 2000

Figure 4



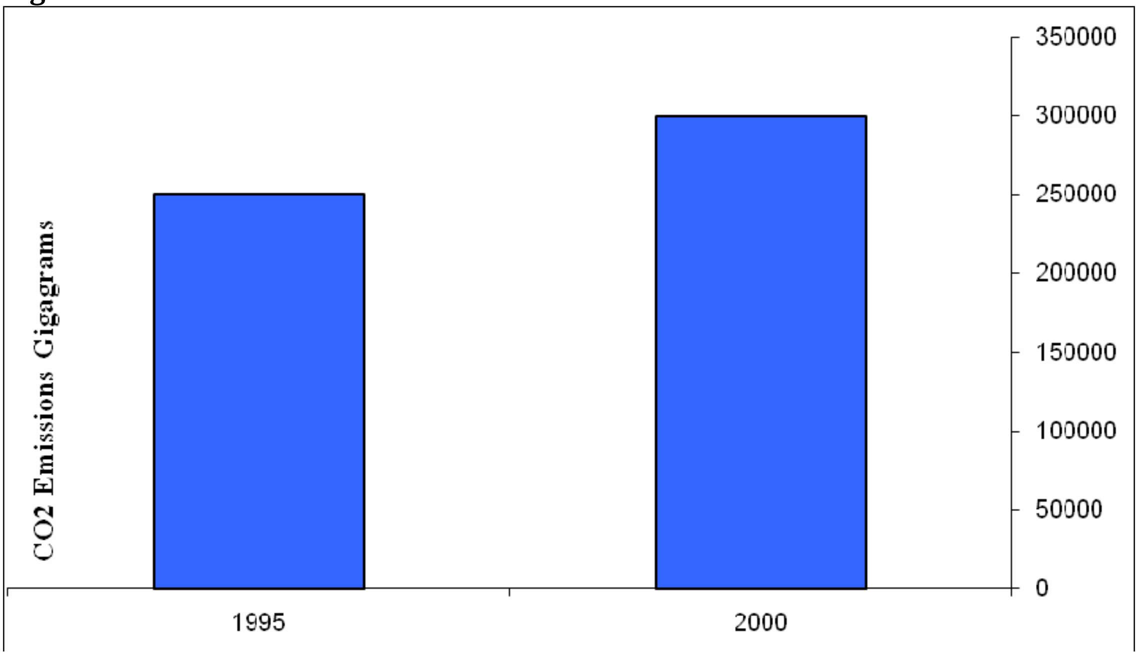
Pollution by mode of transport of Spanish imports, 1995 and 2000

Figure 5



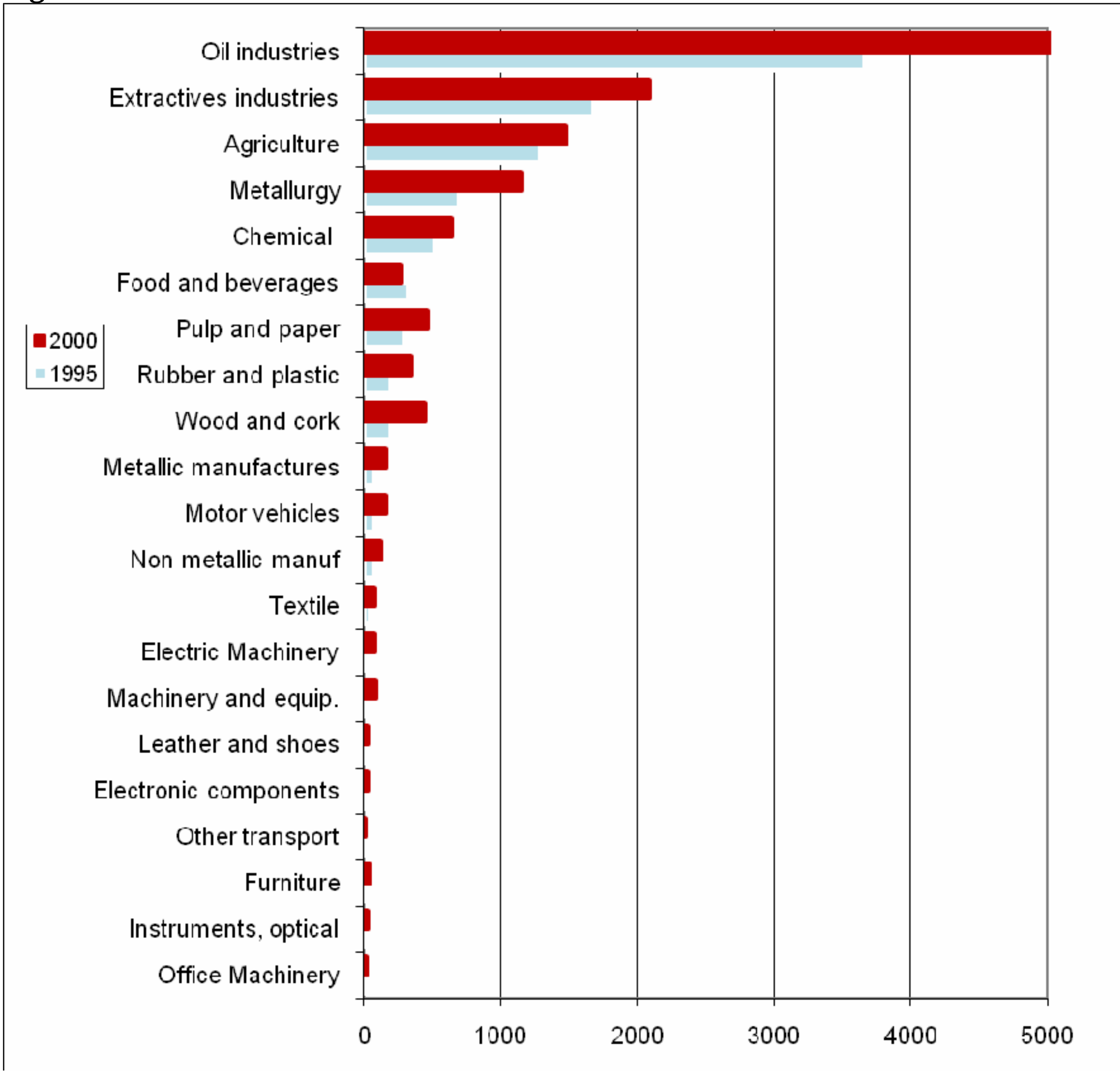
Direct pollution distribution among production and transport, 1995 and 2000

Figure 6



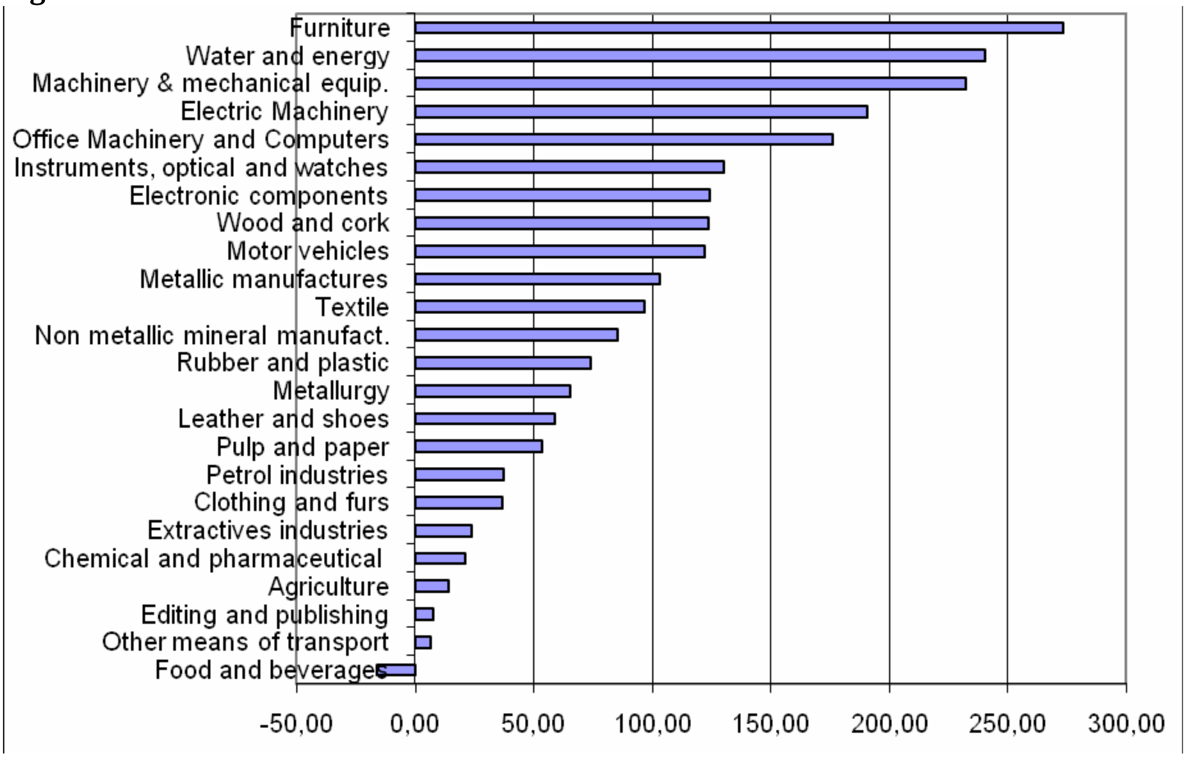
Total pollution associated to intermediate inputs transport, 1995 and 2000

Figure 7



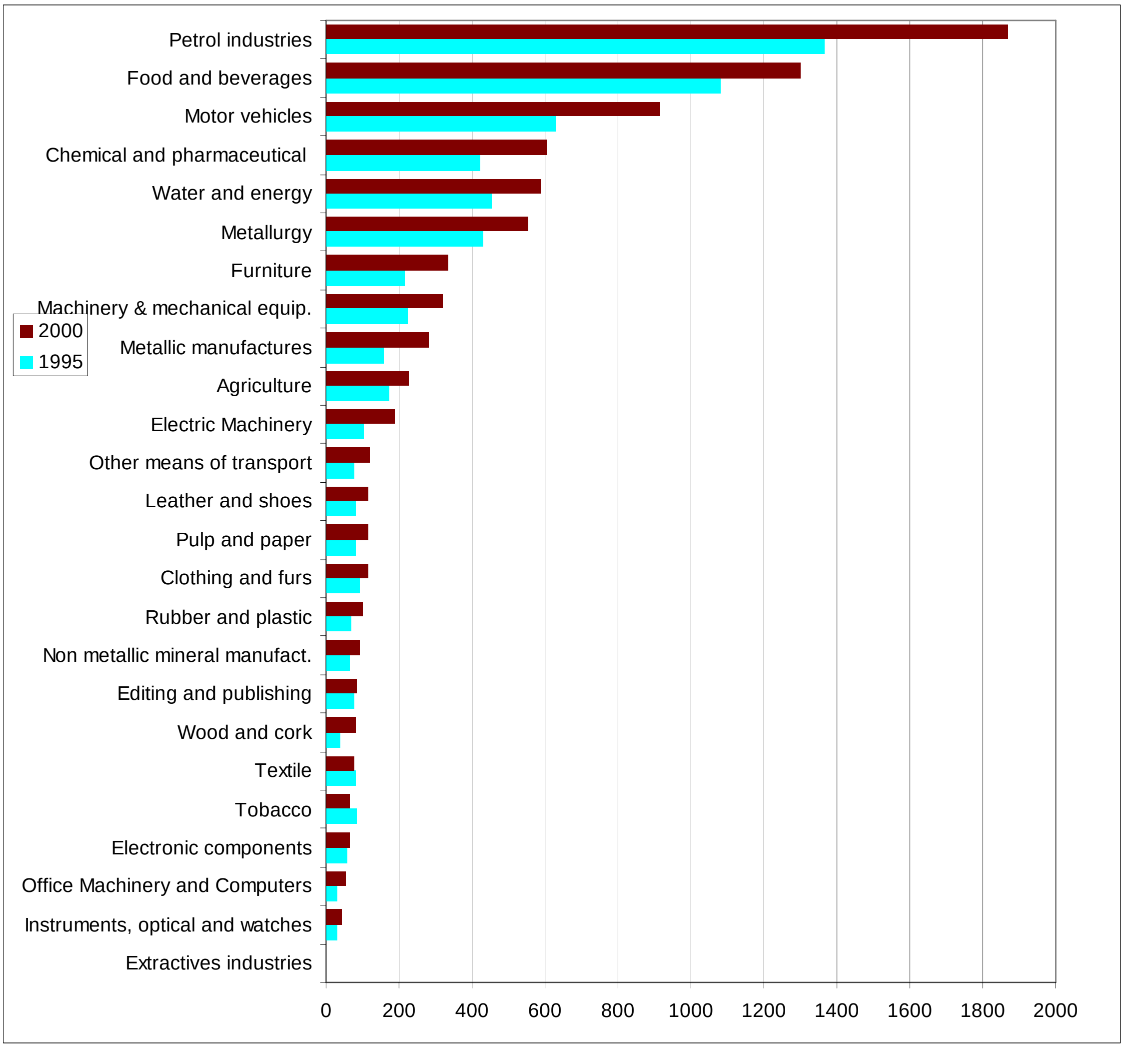
Direct sectoral pollution associated to intermediate inputs transport, 1995 and 2000 (CO_2 gigagrams)

Figure 8



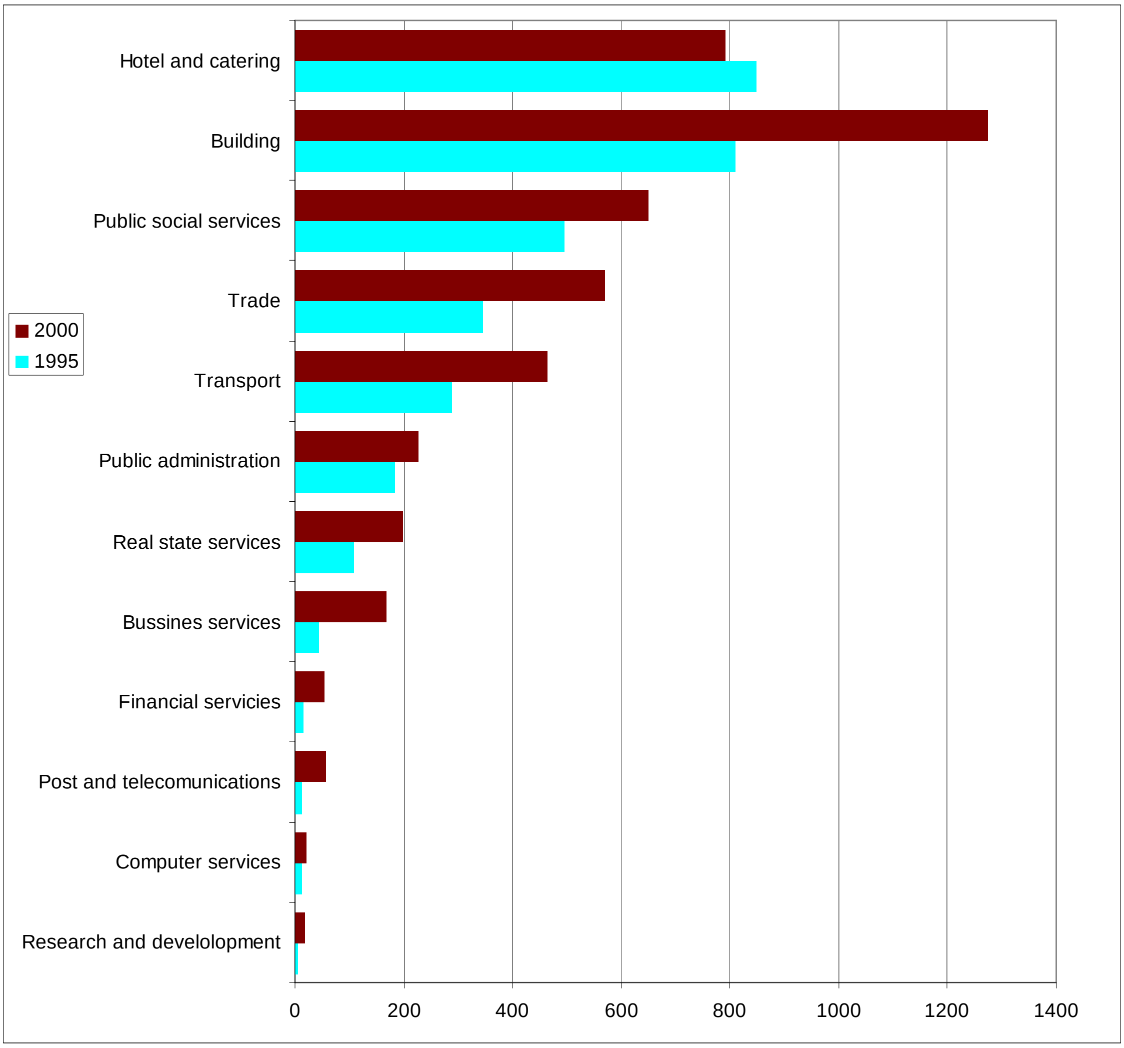
Direct sectoral growth in pollution associated to intermediate inputs transport, 1995 and 2000 (CO_2 gigagrams)

Figure 9



Total sectoral growth in pollution associated to intermediate inputs transport, 1995 and 2000 (CO2 gigagrams), manufactures

Figure 10



Total sectoral growth in pollution associated to intermediate inputs transport, 1995 and 2000 (CO2 gigagrams), services