ENVIRONMENTAL ACCOUNTS

MIR 2015:1

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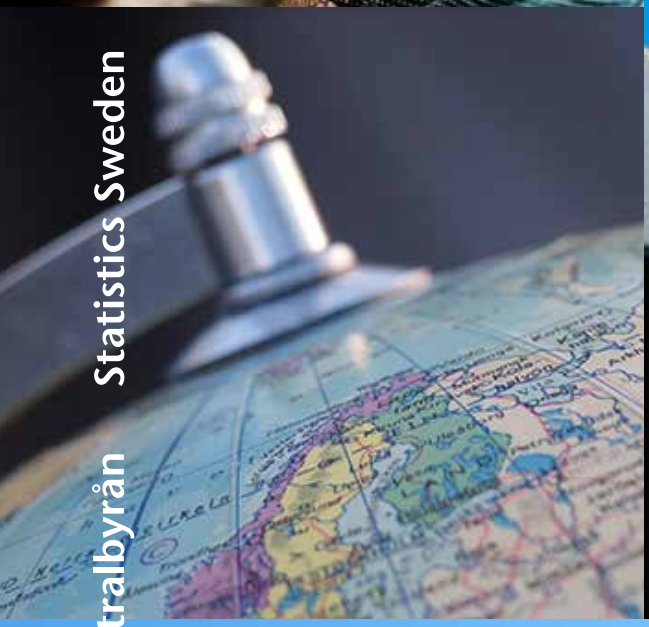

Statistics Sweden

Statistiska centralbyrån

Carbon dioxide emissions from Swedish final consumption 1995–2009

ENVIRONMENTAL ACCOUNTS 2015:1

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Statistics sweden
2015

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Foreword

This report has been compiled by Statistics Sweden on behalf of the Swedish Environmental Protection Agency (Swedish EPA) and is linked to several reports published in the field, see for example "Swedish Consumption and the Global Environment", Swedish EPA 2011 and *Konsumtionsbaserade Miljöindikatorer* (Consumption-based environmental indicators, in Swedish with English summary); Swedish EPA 2012.

The starting-point has been the environmental accounts based on the UN's central framework for environmental-economic accounting.The environmental accounts are a statistical system that describes the links between the environment and the economy. This is done by measuring the contribution from the environment to the economy (e.g. the use of raw material, water, energy and land) and the impact on the environment made by the economy (emissions to air and water, and waste). The environmental accounts system also shows the environment-related transactions that are in the national accounts system.

As a nation with a considerable amount of foreign trade, Sweden is affected by evermore global trade between the countries of world. What we produce and consume and its effects in the form of climate impact are nowadays strongly linked both to the goods and services produced in other countries and to how they are produced.

This report describes the carbon dioxide (CO_2) emissions that are generated by Swedish final consumption in and outside Sweden for the period 1995-2009. This is done by using an environmentally extended input-output analysis together with background data from the multiregional input-output database WIOD (World Input Output Database). In this way, both the emissions generated directly from the use of a particular product or service and the indirect emissions from earlier stages of the production process can be considered. The relatively short time period depends from a general point of view on the scale and complexity involved in compiling such global data and on the lack of annual statistical material, primarily input-output tables, on the global level.

In addition to this report, the results are presented in an interactive way with the help of the map program Statistics eXplorer. This application provides scope for additional analyses and outputs as well as comparisons with variables such as economic growth, trade and environment.

The project has been implemented by the Unit for Environmental Economics and Natural Resources ((Ida Björk, Anders Wadeskog, Johan Stålnacke and Mårten Berglund) at Statistics Sweden with useful comments from Viveka Palm, Nancy Steinbach, Kaisa Ben Daher and Malin Johansson at Statistics Sweden as well as several people at the Swedish EPA.

Statistics Sweden, September 2014

Marie Haldorson

Kaisa Ben Daher

Statistics Sweden would like to thank
All our data providers – private individuals, enterprises, authorities and organisations – who make it possible for Statistics Sweden to produce reliable and up-to-date statistics that meet society's need for information.

Table of contents

Summary

With the help of an environmentally extended input-output model, this report shows how carbon dioxide (CO_2) emissions from Swedish final consumption (private, non-profit and public consumption, and gross capital formation[1]) develop over time, which in the report is referred to as "Swedish consumption". The study describes how imports from a selection of countries and regions affect emissions during the period 1995-2009 as well as how Swedish industries and final users influence the trend. To put Sweden into a larger context, a small-scale comparative review of the development is performed for a selection of countries and regions for the chosen time period.

A comparison between two different methods

The data used in the study comes primarily from the multiregional input-output database WIOD (World Input Output Database). The database allows us to follow trade flows between countries and regions and to consider differences between the production structures of different countries. The WIOD database also gives us more scope to combine underlying variables such as country of origin, industry and domestic actor over a time period, which gives us an even deeper understanding of the trends. The relatively short time period covered in the WIOD depends from a general point of view on the scale and complexity involved in compiling such global data and on the lack of annual statistical material, primarily input-output tables, on the global level.

Data from the Statistics Sweden environmental accounts has been added to the data described above to allow a brief comparison between the two approaches, of which Statistics Sweden uses a simpler method. The method used by Statistics Sweden is a weighted model based on a Swedish input-output model that is supplemented with information about differences in emissions from trade partners compared to emissions in Sweden.

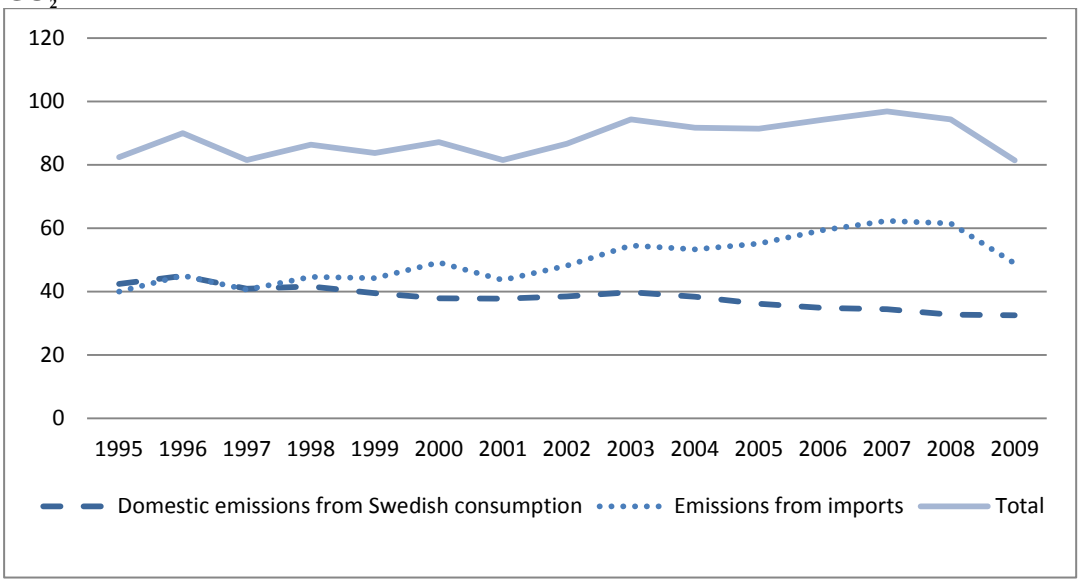
In summary, there is a difference of 6 percent on the total level of emissions from Swedish consumption focusing on carbon dioxide (WIOD with a result in 2009 of 81.4 million tonnes of CO_2 and Statistics Sweden with a result of 76.9 million tonnes of CO_2). If we look at the development over time, the two data sources are close to each other and both show a reduction. For greenhouse gases in total, there is virtually no difference in the calculations. No deeper analysis has been performed in this project in order to compare differences on the product level between the two data-sets. It is possible, however, to perform such an analysis in the future.

[1] Excluding the impact of exports

Only negligible reduction in CO_2 emissions from Swedish final use

CO_2 emissions from Swedish final consumption, calculated using WIOD data, decreased by 1 percent between 1995 and 2009, which is in line with earlier calculations performed by the Statistics Sweden environmental accounts. This insignificant reduction depends on a substantial decrease in domestic CO_2 emissions that can be linked to Swedish final use at the same time as CO_2 emissions from Swedish imports increase at almost the same rate.

Figure 1
CO_2 emissions from Swedish consumption, 1995-2009, millions of tonnes CO_2



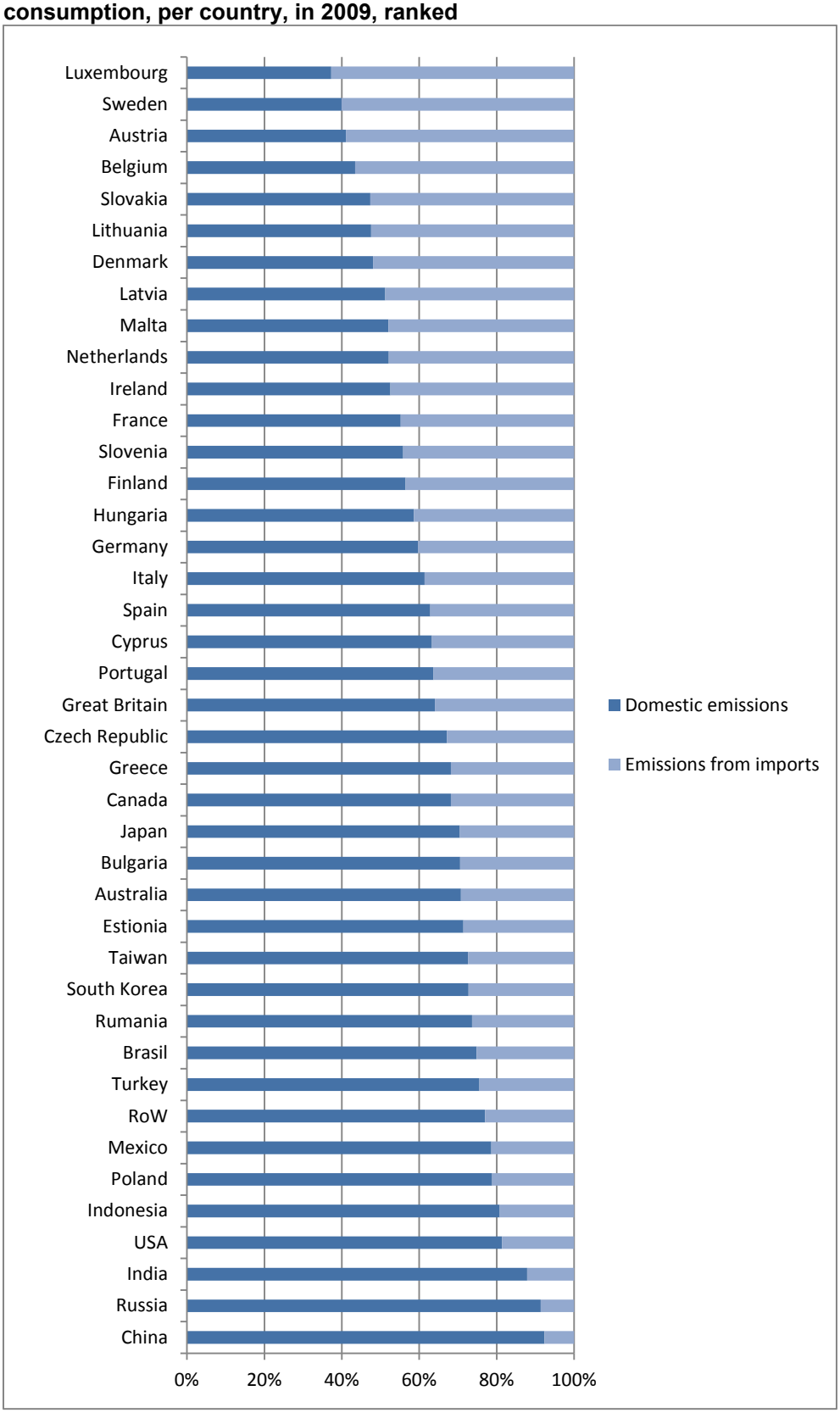
Source: WIOD, processed by Statistics Sweden

The countries from which we import most of our products and input goods and hence import the largest volume of CO_2 can be found in the EU. . The largest actual increase in emissions was generated by imports from China.

Emissions from imports stem primarily from imports related to the manufacturing industry, where the production of machinery, transportation equipment and other manufactured goods are increasing sharply. Here, too, imports from China are the primary cause of the increase.

From the WIOD data, CO_2 emissions from Swedish final consumption can also be compared to corresponding trends in other countries. Compared to other countries, a relatively large proportion of total Swedish CO_2 emissions come from import activities. Only one country in the data, Luxembourg, generated a larger proportion of emissions per capita from imports than Sweden in 2009. During the period 1995-2009, however, a relatively large reduction in Swedish domestic CO_2 emissions linked to final consumption occurred, compared to the vast majority of countries studied. Countries that contributed to increased CO_2 emissions during the period were mainly to be found in Asia and Oceania.

Figure 2
Percentage distribution of CO_2 emissions per capita from domestic consumption, per country, in 2009, ranked



Source: WIOD, processed by Statistics Sweden

1. Background and aim

This project aims to shed light on the environmental impact of the Swedish economy in a global perspective with the help of an environmentally extended multiregional input-output model.

The project describes and visualises the development of CO_2 emissions from domestic final consumption[2] (hereinafter referred to as "Swedish consumption") in and outside Sweden. The project has also made a brief comparison of the results from the multiregional model, developed within the EU's Seventh Framework Programme, and from a weighted model used by Statistics Sweden.

The project has been financed by the Swedish EPA and is linked to several reports published in the field, see for example "Swedish Consumption and the Global Environment", Swedish EPA 2011 and *Konsumtionsbaserade Miljöindikatorer* (Consumption-based environmental indicators, in Swedish with English summary); Swedish EPA 2012.

By performing the analysis with the help of a multiregional input-output model, this projects aims to deepen understanding for how carbon dioxide emissions from Swedish consumption have developed over time and which countries, industries and actors are of greatest significance for the period.

The use of a multiregional input-output model also enables a comparison to be made with the development in other countries. Finally, the project aims to show how the input-output data can be visualised with the help of the map program Statistics eXplorer. Attached to this report, there is a selection of interactive maps and figures available under the following link: www.scb.se/mi1301. Here, there is also scope for further analysis and output as well as comparison with other variables such as economic development, trade and environmental indicators.

1.1. Impact of foreign trade

Swedish emissions and environmental impact are very closely linked to trade with the rest of the world. In total, goods and services worth SEK 1 288 213 were imported in 2009 according to the National Accounts, which corresponded to about 41 percent of GDP in that year. Compared to 1995, this involves an increase in the proportion of imports of GDP, from 33 and 41 percent. As regards which products and services are imported, it is clear that it is mainly manufacturing products, such as chemicals, pharmaceuticals, computers and electronic equipment as well as motor vehicles and other machinery, that are responsible for the largest proportions.

Compared to other EU countries, Sweden imports a relatively large share of the total volume of products and services supplied into the economy,

[2] It includes private households, household non-profit organisations (HNPO), public consumption and gross capital formation (gross fixed capital formation, investments in inventory and valuables). The calculations do not therefore include the entire effect of exports, something which is discussed in Chapter 4.

something which can be seen in Table 1 below. Compared to the total supply of products and services into the economy, (i.e. imports plus domestic production[3]), the proportion of imports amounted to about 18 percent in 2009. The corresponding proportion for the EU-26 region was 16 percent.

The products and services that made up the largest import share of total supply in 2009 were manufacturing products, amounting to 35 percent of total supply. As manufacturing products are responsible for a large share of Sweden's total imports, they are of considerable significance for environmental impact in the form of CO_2 emissions. Compared to EU-26, a relatively large volume of imports was used in relation to domestic output in the Swedish production of chemical products, machinery, certain business services and transport services.

Table 1
Proportion of imports to total supply for Sweden and EU-26, 2009

	Sweden			EU-26		
1000 US dollars	Imports	Domestic Production	Share of imports total supply	Imports	Domestic Production	Share of imports total supply
Agriculture, forestry and fishing	12	15	45%	588	712	45%
Manufacturing	100	187	35%	3 760	7 552	33%
of which food, beverage and tobacco	9	19	32%	336	1 147	23%
of which textile and clothing	5	1	81%	272	298	48%
of which wood, paper and petroleum	10	43	19%	341	1 055	24%
of which chemicals, plastics and minerals	28	50	36%	1 099	2 347	32%
of which machinery, transportation equipment, n.e.c	48	73	40%	1 712	2 706	39%
Electricity, heating and water supply	1	17	5%	36	844	4%
Construction activities	0	42	0%	15	2 323	1%
Trade	1	76	2%	48	3 066	2%
Transport	14	55	20%	226	1 587	12%
Other services	32	364	8%	761	13 807	5%
Total output	169	757	18%	5 682	29 892	16%

Source: WIOD (data based indirectly on each country's national accounts)[4]

[3] Measured at basic price in accordance with WIOD. The data differs from the most recently published National Accounts due to revisions and new classifications. WIOD has been chosen as the accounting source as it forms the basis of the input-output calculations presented in the report.

[4] Total output includes Cif/fob adjustments and data on Swedish consumption abroad and is therefore not the sum of the sub-items presented. For more information on Cif/fob (Cost, insurance, freight/Free on Board) adjustments, please see: System of National Accounts 1993, (SNA 1993).

2. Methodology and data sources

2.1. Input-output methodology

An environmentally extended input-output analysis has been used to examine CO_2 emissions from Swedish consumption. This method includes both emissions generated directly from the use of an input in a specific industry and emissions generated at a previous stage of the production process. Put simply, we can say that the analysis includes both the emissions generated as a result of e.g. a vehicle being manufactured, and the indirect effects from the production of engines, car bodies, and other necessary components produced at earlier stages of the vehicle production process. Similarly, the CO_2 emissions generated by the inputs needed to produce engines, car bodies and other necessary components are also included in order to accurately reflect the entire production supply to the economy needed to produce the product (in this case the vehicle). See also Appendix 1 for a brief description of how the effect at the various production stages changes.

In this project, we have chosen to use a multiregional input-output model to be able to analyse which countries and industries are significant for Swedish emissions that are generated by consumption. The national calculations performed by Statistics Sweden have been added to this to enable a comparison with previously calculated results. The differences in methodology and underlying data are described in the *Underlying data* section below.

The calculations presented refer to the global distribution of emissions generated by domestic final use (referred to in the report as "Swedish consumption") and do not include emissions generated by output that is subsequently exported. It appears instead as a consequence of the import demand from other countries both for inputs and directly to domestic final use. Since this report only looks at Swedish domestic final use, only some of the emissions from our production will be included. This is discussed in more detail in Section 4, in which results that include the effects of exports are also presented.

2.2. Data sources

2.2.1. World input-output database (WIOD)

Most of the results presented in this report are based on data from WIOD (World Input-Output Database)[5]. WIOD is a collection of input-output tables for 27 EU Member States and 134 other countries for the period 1995-2009.

The data from WIOD can in brief be described as a combination of national input-output tables, in which the use tables have been extended to include

[5] www.wiod.org

country and industry of origin. This differs from a national input-output table, in which only information about use generated from domestic production or imports can be found.

National and multiregional input-output model
Figures 3 and 4 illustrate two simplified national and multiregional input-output tables:

Figure 3
National input-output table

	Industry	Final use		Total
Industry	Intermediate consumption	Domestic consumption	Export	Total output
	Imports			
	Value added			
	Total output			
Satellite data	Emission coefficients= emissions/output			

The table above shows a national input-output table, in which each row represents production in a specific industry (or sector), and how this production is divided into use of inputs (dashed line) or final use. Each column indicates which intermediate inputs (type of input products) are needed to produce in a specific industry. This use is then divided into whether it stems from imports or domestic production.

Figure 4
Multiregional input-output table for three countries (Country A, B and Rest of the World (RoW)))

		Intermediate consumption			Final consumption			Total
		Country A Industry	Country B Industry	RoW Industry	Country A	Country B	RoW	
Country								
A	INDUSTRY	Intermediate consumption of domestic production	Intermediate consumption in country B of exports from country A	Intermediate consumption in RoW of exports from country A	Final consumption of domestic prod-uction	Final consumption in country B of exports from country A	Final consumption in RoW of exports from country A	**Total output in country A**
B	INDUSTRY	Intermediate consumption in country A of exports from country B	Intermediate consumption of domestic production	Intermediate consumption in RoW of exports from country A	Final consumption in country A of export from country B	Final consumption of domestic productio n	Final consumption in RoW of exports from country B	**Total output in country B**
RoW	INDUSTRY	Intermediate consumption in country A of exports from RoW	Intermediate consumption in country B of exports from RoW	Intermediate consumption of domestic production	Final consumption of domestic prod-uction	Final consumption in country B of exports from RoW	Final consumption of domestic production	**Total output in RoW**
		Value added	Value added	Value added				
		Total output in country A	**Total output in country B**	**Total output in RoW**				
Satellite data		Emission coefficients= emissions/output	Emission coefficients= emissions/output	Emission coefficients= emissions/output				

In the simplified multiregional input-output table shown in Figure 2 above, the national table has been extended to include information about international trade between countries and industries. In this way, we create a table in which the rows represent both specific industries and countries, and in which the use is broken down both by industry and by country. Each column represents the intermediate input needed to produce a commodity or service in a specific industry in a particular country, as well as in which country this input originates.

In order to then calculate the emissions generated by a certain production value (intensities), the production value (output) in the above tables is multiplied by the emission coefficients (emission/production value) of the sectors. In this way, we obtain the total upstream emissions associated with the use of a particular product in a specific country. In order to create consistent time series, the data from WIOD is, as far as possible, based on national supply and use (SUT) tables that are subsequently converted into input-output tables. The "fixed product-sales structure[6]" assumption has been employed here, which means that the final input-output tables are

[6] This assumption means that each product has its own unique sales structure irrespective of the industry in which it is produced.

expressed in industry x industry matrices and not in product x product matrices, which are the norm for Swedish national and environmental accounts. This means that the final environmentally extended multiregional input-output tables can provide answers to questions such as what proportion of total CO_2 emissions from imports is a particular industry responsible for, rather than what contribution a specific product makes.

To be able to extend the national input-output tables to a multiregional input-output table, bilateral trade statistics have been of key significance for the WIOD project. Here, mostly data from the UN COMTRADE database at the HS6-digit product level (a product classification called "harmonized system") has been utilised to cover bilateral trade in goods between the countries of the world. Trade in services has mainly been covered using data from OECD, Eurostat, IMF and WTO.

In total, there is data for 40 individual countries in the database, covering more than 85 percent of world GDP. The countries included are described in Table 1 below. In addition to these countries, an aggregate called RoW (Rest of the World) has been introduced as a proxy for the remaining countries of the world. This aggregate includes the majority of countries in South and South-East Asia, Central Asia, South America and Africa, as well as non-EU countries in Europe such as Norway and Switzerland. Unfortunately, it is not possible to present these countries separately in the data and this is why they have been compiled as an aggregate.

In this report and in the enclosed map program, six country groupings have been introduced to facilitate the analysis. These are: Sweden; The remaining EU Member States (hereinafter referred to as EU-26); North America; BRIC[7]; The rest of Asia/Oceania and RoW (Rest of the World).

Table 2
Countries and country aggregates represented in the data (emissions from imports)

EU-26	North America	BRIC	Rest of Asia/ Oceania	RoW
Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, UK	Canada, Mexico, United States	Brazil Russia India China	Australia, Indonesia, Japan, South Korea, Taiwan, Turkey	Other countries. Also includes EFTA countries such as Norway and Switzerland.

Source: WIOD

The report presents data from the period 1995-2009. This relatively short time period is in general due to the scope and complexity involved in compiling such global data. Since countries are not obliged to compile annual input-output data, and since it is not compulsory to produce emissions data per industry that is needed in the calculation, the data has to be constructed from the bottom. For more information on the methods and sources used regarding WIOD, see: Timmer (ed) (2012).

[7] BRIC is an acronym for: Brazil, Russia, India and China and represents four large growth markets.

A short discussion of uncertainties in the WIOD underlying data is also presented in Appendix 3.

2.2.2. Statistics Sweden's environmental accounts

Data from the Statistics Sweden environmental accounts has been added to the data source described above in order to enable a comparative study. The method used by Statistics Sweden to calculate similar paradigms is a weighted model based on a Swedish input-output model that is supplemented with information about differences in emissions from trade partners compared to emissions in Sweden. The ratio between the foreign emissions per dollar and emissions in Sweden per dollar is used as a weight to scale the Swedish emissions factors used in the analysis up or down.

This method has previously been used in several reports published by the Swedish EPA (see e.g. "Swedish Consumption and the Global Environment", Swedish EPA 2011, and Konsumtionsbaserade Miljöindikatorer (Consumption-based environmental indicators, in Swedish with English summary); Swedish EPA 2012.

The difference between the two methods can be seen in Table 3 below. Both methods indicate a strong increase in emissions from imports while domestic emissions have fallen rapidly over the period. Seen on the whole, a very small change during the period 1995-2009 is seen.

Table 3
Method comparison – Emissions of CO_2 and greenhouse gases from Swedish consumption according to Statistics Sweden and WIOD, millions of tonnes.

	CO_2			Greenhouse gases, CO_2 equivalents.		
	1995	2009	Change	1995	2009	Change
Domestic emissions from Swedish consumption (Statistics Sweden)	41.5	31.0	-25%	53.0	39.6	-25%
Emissions from imports (Statistics Sweden)	36.8	45.8	25%	50.2	64.4	28%
Total	78.3	76.9	-2%	103.2	104.0	1%
Domestic emissions from Swedish consumption (WIOD)	42.4	32.5	-23%	53.4	40.8	-24%
Emissions from imports (WIOD)	40.0	48.9	22%	52.6	62.8	19%
Total	82.4	81.4	-1%	105.9	103.6	-2%
Differences between Statistics Sweden/WIOD	***1995***	***2009***		***1995***	***2009***	
Domestic emissions from Swedish consumption	*98%*	*95%*		*99%*	*97%*	
Emissions from imports	*92%*	*94%*		*95%*	*102%*	
Total	*95%*	*94%*		*97%*	*100%*	

Source: WIOD and Swedish Environmental Accounts, Statistics Sweden

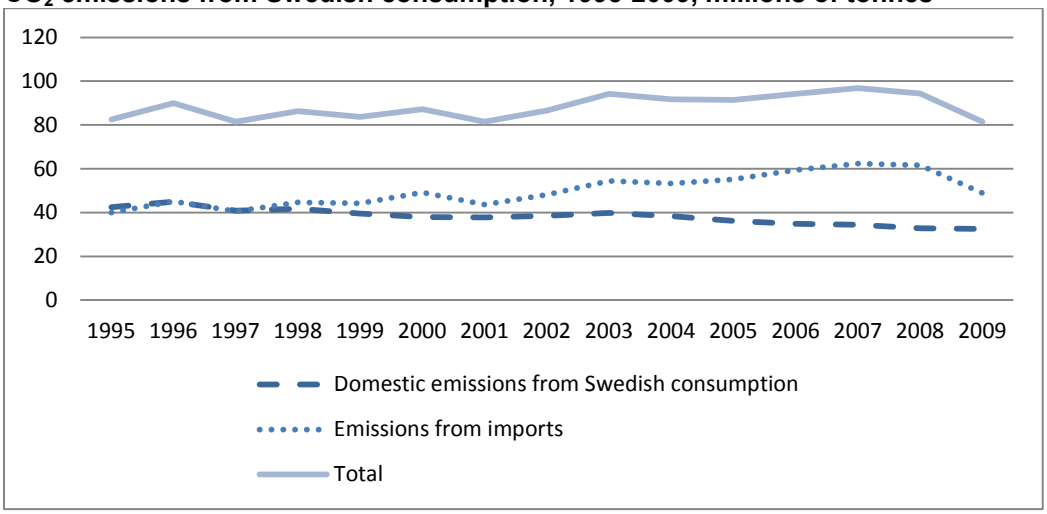
As can be seen in Table 3 above, there is a level discrepancy between the two methods. The level discrepancy can primarily be seen for emissions generated by imports and amounts to about 3.1 million tonnes of CO_2 in 2009 for CO_2 emissions and -1.6 million tonnes of CO_2 equivalents for greenhouse gases.

The level discrepancy depends in all probability on the differences in methodology between the two sources as well as differences in the way countries' emission intensities are handled. It may also depend on general difficulties in modelling trade and production conditions on the global level in the WIOD data and uncertainties regarding the impact of other countries (RoW). Both methods do follow the same trend over the period studied, however.

3. Results

Seen over time, domestic CO_2 emissions generated by Swedish consumption have decreased considerably. Between 1995 and 2009, emissions fell by just over 23 percent or almost 10 million tonnes of CO_2. During the same period, however, emissions generated by import activities have risen. In all, this means that the total CO_2 emissions generated by Swedish consumption decreased by just over 1 percent between 1995 and 2009.

Figure 5
CO_2 emissions from Swedish consumption, 1995-2009, millions of tonnes



Source: WIOD, processed by Statistics Sweden

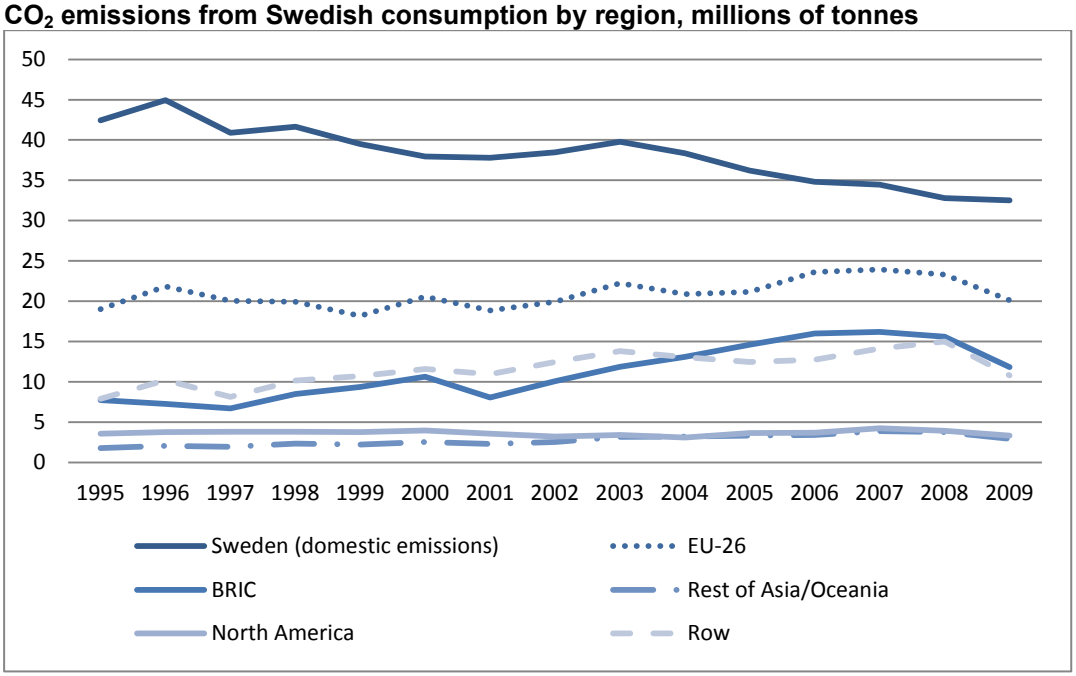
The following chapter focuses on CO2 emissions generated by Swedish imports.

3.1. Swedish CO_2 emissions from imports by country

The sharp increase in emissions generated by our import activities can primarily be seen in some developing countries, such as the BRIC countries, while there has been a certain reduction in emissions generated by imports from North America and the majority of EU Member States.

In total, the EU region was still responsible for the largest share of total CO_2 emissions from imports in 2009. The region did, however, become less significant for Sweden's total CO_2 emissions compared to other countries during the period. In 2009, EU-26's share of Sweden's emissions from imports amounted to 41 percent compared to 48 percent in 1995. The corresponding increase can primarily be seen among the BRIC countries, who increased their share from 19 to 24 percent during the same period.

Figure 6
CO_2 emissions from Swedish consumption by region, millions of tonnes



Source: WIOD, processed by Statistics Sweden

Table 4 below shows the CO_2 emissions from Swedish consumption from all the countries represented in the data for the 1995-2009 period. The country responsible for the largest increase during the period was China, closely followed by the RoW aggregate. The UK and United States were responsible for the largest decrease in CO_2 emissions from imports.

Table 4
CO_2 emissions generated by imports to Sweden, by country, 1995 and 2009

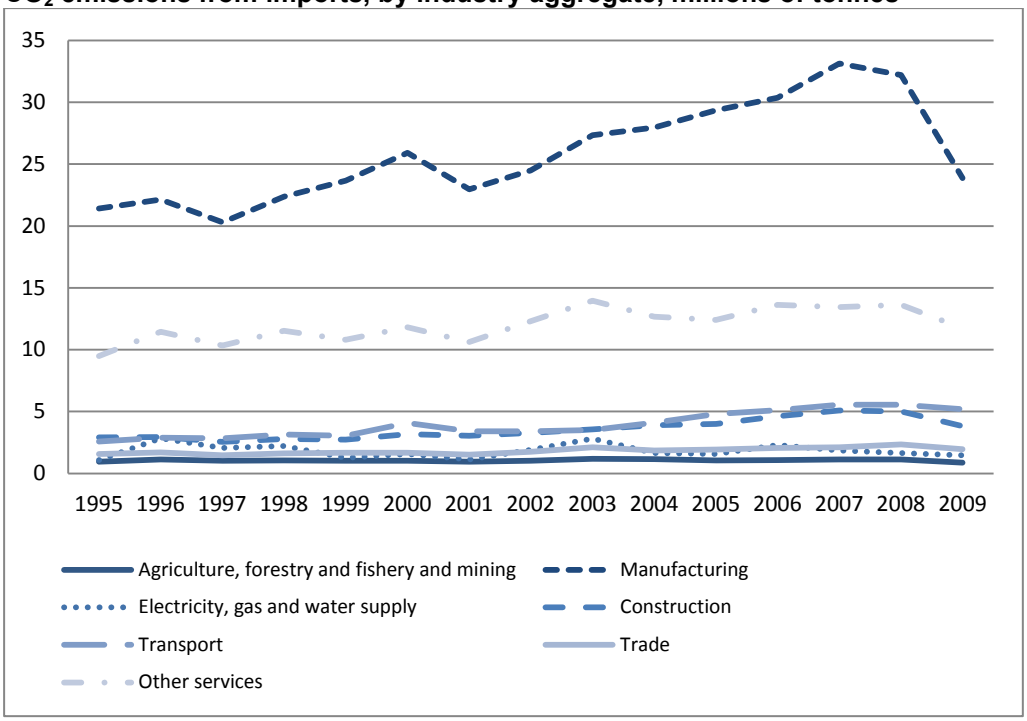
	1995	2009	Change	% of total imports -09
Australia	224 493	293 481	31%	1%
Belgium	997 834	1 000 931	0%	2%
Brazil	159 000	370 589	133%	1%
Bulgaria	163 383	141 407	-13%	0%
Cyprus	5 204	7 020	35%	0%
Denmark	1 885 881	2 442 389	30%	5%
Estonia	437 566	370 610	-15%	1%
Finland	1 490 878	2 418 663	62%	5%
France	1 043 733	1 121 181	7%	2%
Greece	70 681	100 228	42%	0%
India	710 091	1 240 096	75%	3%
Indonesia	168 473	248 559	48%	1%
Ireland	163 808	145 439	-11%	0%
Italy	791 863	664 430	-16%	1%
Japan	521 716	664 210	27%	1%
Canada	472 952	515 703	9%	1%
China	3 159 667	6 138 550	94%	13%
Latvia	102 173	79 425	-22%	0%
Lithuania	187 034	152 037	-19%	0%
Luxembourg	67 427	13 583	-80%	0%
Malta	2 698	9 357	247%	0%
Mexico	116 458	123 001	6%	0%
Netherlands	1 578 750	1 778 210	13%	4%
Poland	1 635 480	1 996 574	22%	4%
Portugal	188 125	182 618	-3%	0%
RoW	7 897 500	10 777 690	36%	22%
Romania	179 964	227 344	26%	0%
Russia	3 699 639	4 058 976	10%	8%
Slovakia	184 685	198 290	7%	0%
Slovenia	33 529	51 184	53%	0%
Spain	516 199	615 462	19%	1%
UK	3 174 579	1 649 885	-48%	3%
South Korea	435 432	714 374	64%	1%
Taiwan	318 720	572 651	80%	1%
Czech Republic	341 024	497 956	46%	1%
Turkey	117 177	417 481	256%	1%
Germany	3 435 781	3 655 064	6%	7%
Hungary	134 001	255 240	90%	1%
United States	2 989 741	2 671 628	-11%	5%
Austria	194 345	354 624	82%	1%
Total	**39 997 682**	**48 936 139**	**22%**	**100%**

Source: WIOD, processed by Statistics Sweden

3.2. Swedish CO_2 emissions from imports, by industry

Swedish demand for finished products drives volumes of emissions generated by imports to a varying degree. The following industries that import to Sweden are responsible for the largest emissions. : the manufacturing industry, followed by other service industries[8], e.g. the hotel and restaurant industry and vehicle rental industry, something that can be seen in Figure 7 below. Within the manufacturing industry, it is primarily the manufacture of machinery, transportation equipment, other manufacturing and recycling that are responsible for the largest CO_2 emissions, making up 40 percent of the manufacturing industry's total estimated emissions from imports.

Figure 7
CO_2 emissions from imports, by industry aggregate, millions of tonnes



Source: WIOD, processed by Statistics Sweden

Seen over time, the transport industry is responsible for the largest increase in absolute terms, followed by the manufacturing industry and other service industries. Within the manufacturing industry, it is once again the manufacture of machinery, transportation equipment, other manufacturing and recycling that are responsible for the largest increase.

[8] See Appendix 2 for information on which sub-industries are included in the reported industry aggregate

Table 5
CO_2 emissions from imports to Swedish industries, by industry aggregate, 1995 and 2009, millions of tonnes

Total emissions from imports, by industry	1995	2009	Change	Share in 2009
Agriculture, forestry, fishing and mining	0.9	0.9	-8%	2%
Manufacturing industry	21.4	23.9	12%	49%
of which food, beverage and tobacco	2.7	3.6	33%	7%
of which textile and clothing	2.6	1.6	-40%	3%
of which wood, paper and petroleum	3.7	3.7	0%	8%
of which chemicals, plastics and minerals	3.9	4.9	26%	10%
of which machinery, transportation equipment, other manufac. and recycling	8.6	10.2	18%	21%
Electricity, gas, heating and hot water supply	1.1	1.5	36%	3%
Construction	2.9	3.8	31%	8%
Trade	1.6	2.0	26%	4%
Transport	2.6	5.2	102%	11%
Other services	9.5	11.7	23%	24%
Total	40.0	48.9	22%	100%

Source: WIOD, processed by Statistics Sweden

3.2.1. CO_2 emissions from imports, from three Swedish sub-industries

A brief review of CO_2 emissions from Swedish import activities from three Swedish industrial groups follows below: Manufacture of machinery, transportation equipment, other manufacturing and recycling; Textile and clothing industry; and the food, beverage and tobacco industry[9]. We have chosen to study these three industrial groups more closely, mainly because of the stability and quality of the basic data in the WIOD.

CO_2 emissions from the machinery, transportation equipment, other manufacturing and recycling industry

CO_2 emissions from imports that can be linked to the machinery, transportation equipment, other manufacturing and recycling industry in Sweden made up just over 20 percent of total emissions in 2009. They therefore constituted a very large share of the total Swedish CO_2 emissions from imports.

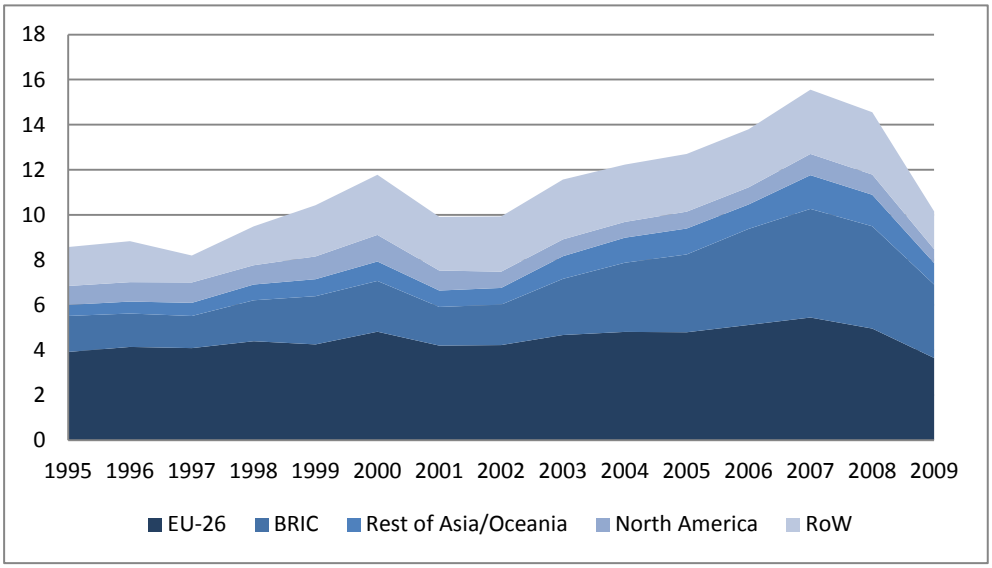
During the 1990s, the majority of the emissions from imports from this industrial group could be traced to the EU region, with Germany as a significant protagonist. At the beginning of the 2000s, however, emission from the BRIC countries began to increase sharply, which has resulted in a levelling-out of the contributions from the regions. In 2009, the BRIC region was responsible for a third of total emissions from imports, thereby matching the entire contribution from EU-26.

The increase that can be seen from this industrial group can mostly be explained by an increase in emissions from China. In total, emissions from

[9] For more information on which sub-industries are included in the industry aggregate, please see Appendix 2.

the industry that can be linked to imports from China rose by as much as 1.5 million tonnes of CO_2 or 197 percent between 1995 and 2009. The development in China is also the main reason behind the increase up until 2007 and the reduction that can be seen during the crisis years 2008-2009. Other countries that contributed to the industrial group's increase in emissions during the period are India and South Korea while emissions generated from imports from the United States and the UK decreased to a corresponding degree.

Figure 8
CO_2 emissions from imports generated by machinery, transportation equipment, other manufacturing and recycling industries, millions of tonnes



Source: WIOD, processed by Statistics Sweden

Looking at the various sub-industries that make up the industry aggregate above, the manufacture of transportation equipment industry was responsible for the biggest increase during the period. In total, emissions from imports generated by the manufacture of transportation equipment increased by 69 percent or 1.3 million tonnes of CO_2 between 1995 and 2009, and was therefore responsible for the majority of the increase for the entire industry aggregate. Imports mainly from China, RoW and India are behind the increase.

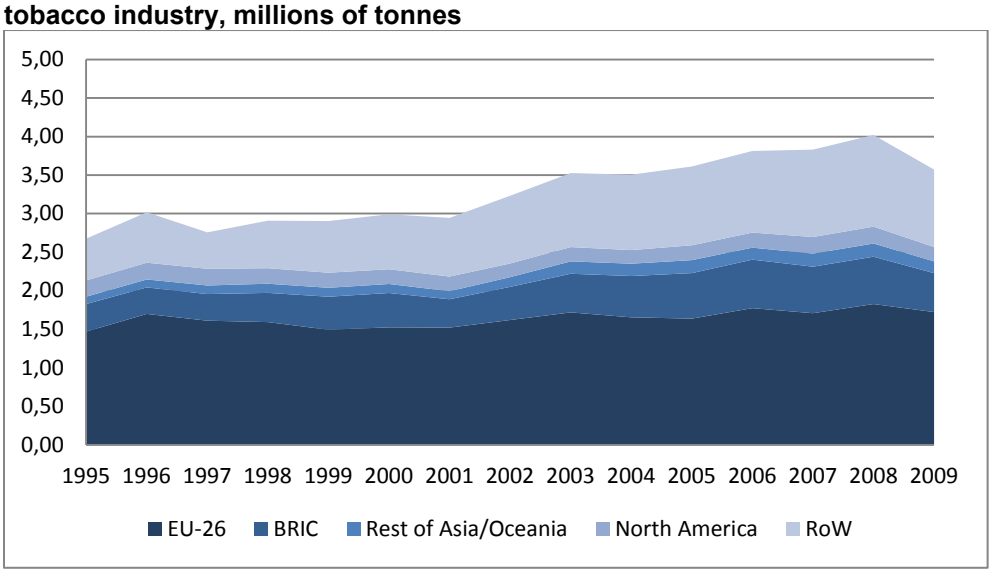
CO_2 emissions from the food, beverage and tobacco industry

The Swedish food, beverage and tobacco industry was responsible for 7 percent of total CO_2 emissions generated by imports for Swedish consumption in 2009.

The majority of the emissions from imported products were also to be found in the EU-26 region during the period, with a greater share from other regions. For this industry aggregate, imports from RoW were responsible for the sharpest rise, followed by EU-26 and the BRIC region. Within the EU-26, there was primarily an increase from imports from Germany and Denmark while China was responsible for the biggest increase of the BRIC countries. In 2009, imports from China were responsible for 7 percent of the total emissions that can be linked to the industry's imports, which can be compared to 9 percent each for Germany

and Denmark. Since the data for other countries (RoW) is aggregated and cannot be presented separately, it is very difficult to say which countries are influencing the development here.

Figure 9
Swedish CO_2 emissions from imports generated by the food, beverage and tobacco industry, millions of tonnes



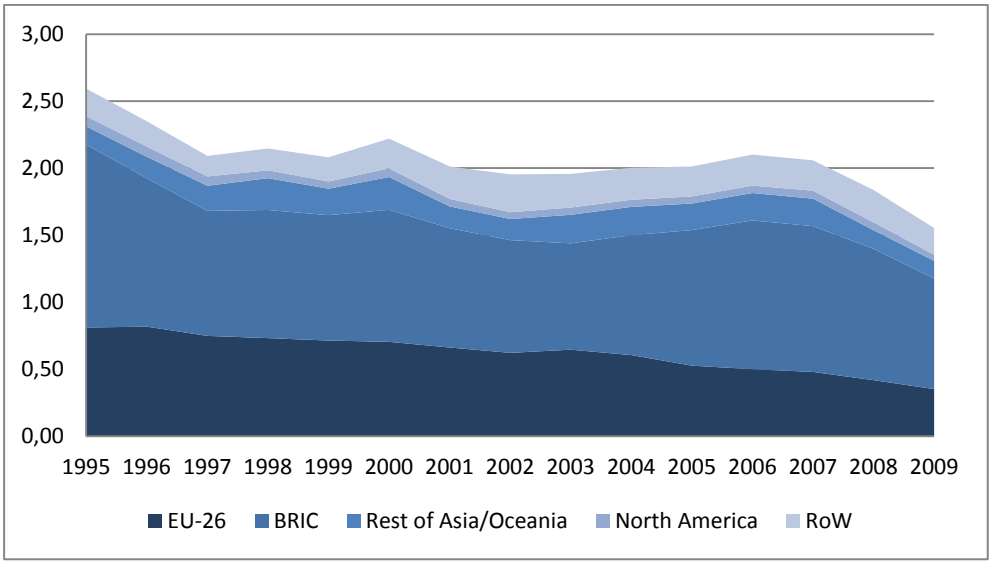
Source: WIOD, processed by Statistics Sweden

CO_2 emissions abroad from the textile and clothing industry

The Swedish textile and clothing industry was responsible for a mere 3 percent of the total CO_2 emissions generated by imports from Swedish consumption in 2009. The industry's emissions from imports have also decreased sharply during the period and hence differ from many other industries represented in the data. In total, emissions from imports that can be linked to the textile and clothing industry fell by 40 percent between 1995 and 2009.

During the whole period, the BRIC countries were responsible for the majority of the emissions with China again being the main contributor. Seen as a whole, imports from China were responsible for 42 percent of the emissions generated in the industry in 2009, a share that has increased since 1995 but seems to have stabilised in recent years. Instead, other countries classified as RoW have recently increased their share of imports, which seems to be well in line with an increased localisation of the industry to, for example, South and South-East Asia.

Figure 10
Swedish CO_2 emissions from imports, textile and clothing industry, millions of tonnes

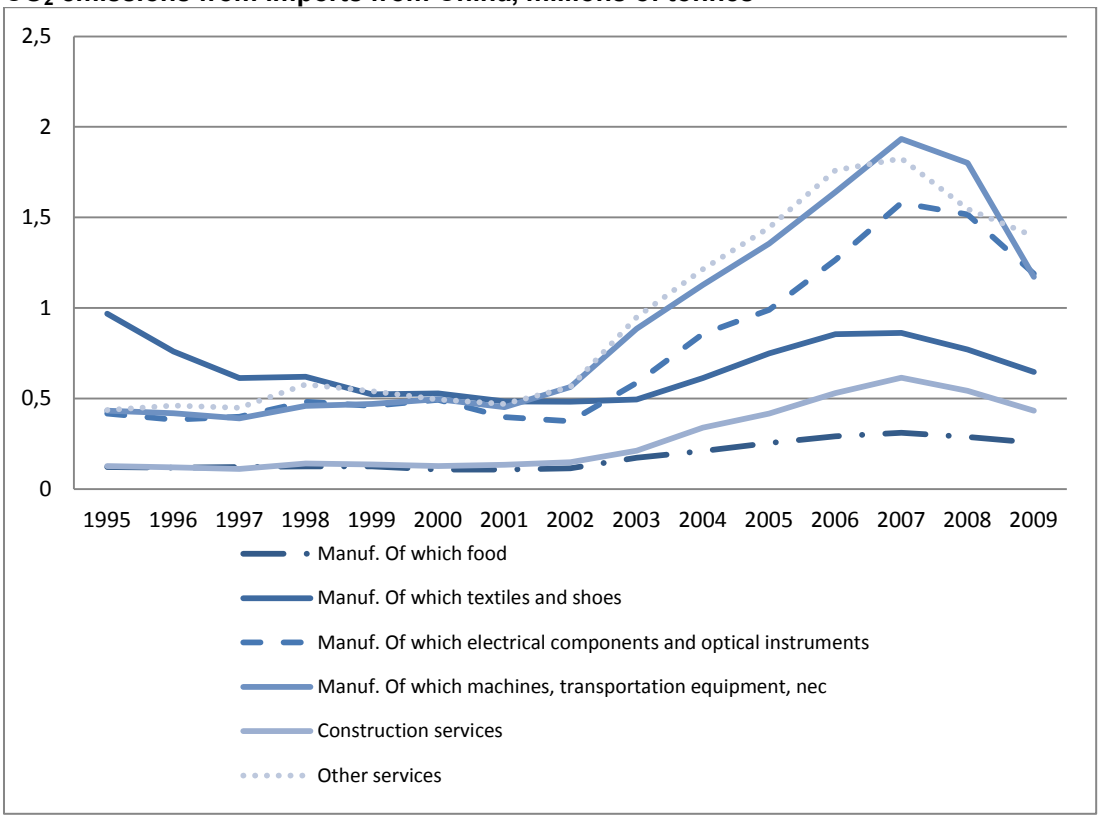


Source: WIOD, processed by Statistics Sweden

3.2.2. CO_2 emissions from imports from China

Sweden's CO_2 emissions from imports have, as described above, increased sharply in recent years. A large part of this increase has been generated in the BRIC countries and particularly in China. Figure 11 and Table 6 below show how the development in China took place during the period and which sub-industries explain the trend.

Figure 11
CO_2 emissions from imports from China, millions of tonnes



Source: WIOD, processed by Statistics Sweden

In total, emissions from imports from China increased by as much as 94 percent or almost 2 million tonnes of CO_2 between 1995 and 2009. By far the biggest increase in emissions occurred from 2001, when China also became a member of the World Trade Organisation (WTO), something which probably explains this pattern. The increase from 2001 onwards amounts to as much as 3.6 million and corresponds to almost 70 percent of the total Swedish increase in emissions from imports during this period. With this increase, China has taken over top spot as the country with the largest single impact on total Swedish emissions from imports, a position that was held by Germany and Russia in 1995.

The increase that can be seen since 2001 can be found in the majority of the industries studied but is led by the manufacturing industry and above all the manufacture of machinery, transportation equipment, other manufacturing and recycling. Industries such as construction, trade and transport, as well as other service industries increased sharply during this period.

Table 6
CO_2 emissions from imports from China, in 1995 and 2009, tonnes

Industry aggregate	1995	2009	Change	Share in 2009
Agriculture, forestry, fishing and mining	25 027	35 753	43%	1%
Manufacturing industry	2 404 600	3 841 654	60%	63%
of which food, beverage and tobacco	122 445	256 693	110%	4%
of which textile and clothing	969 156	647 521	-33%	11%
of which electrical components and optical instruments	416 850	1 188 824	185%	19%
of which chemicals, plastics and minerals	464 011	576 904	24%	9%
of which machinery, transportation equipment, other manufac. and recycling	764 958	2 270 807	197%	37%
Electricity, gas, heating and hot water supply	36 721	62 842	71%	1%
Construction	126 527	433 399	243%	7%
Trade	56 805	183 380	223%	3%
Transport	74 236	185 656	150%	3%
Other services	435 750	1 395 867	220%	23%
Total	3 159 667	6 138 550	94%	100%

Source: WIOD, processed by Statistics Sweden

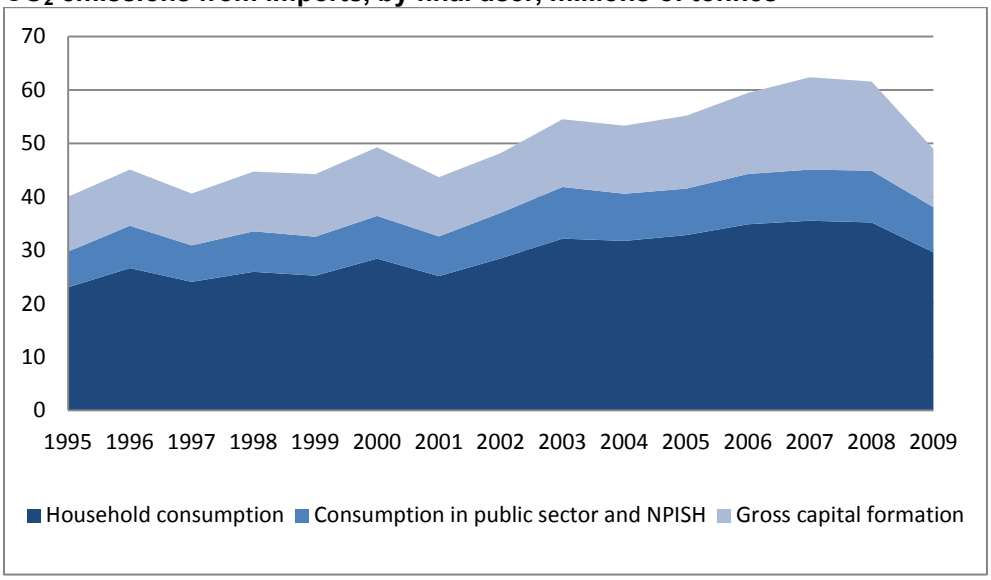
As far as individual sub-industries are concerned, the manufacture of electrical components and optical instruments is responsible for the single largest share of total CO_2 emissions generated by imports from China. In 2009, the industry was responsible for as much as 19 percent of the emissions generated by the imports. The textile industry, machinery, transportation equipment and construction were also responsible for significant shares of the total emissions from Chinese imports.

3.3. Swedish emissions by final user

The following section describes which actors (or final users) in the Swedish economy had the greatest emissions impact during the period. The actors studied are divided into three groups: private households; public sector and households' non-profit institutions serving households (NPISH); and gross capital formation. These are illustrated in Figures 12-14 below.

The total emissions from imports are primarily generated from activities in households. Private consumption was responsible for 60 percent of the emissions generated by imports for Swedish consumption in 2009. Seen over time, private households were also responsible for the largest increase in CO_2 emissions, followed by consumption in NPISH and the public sector.

Figure 12
CO_2 emissions from imports, by final user, millions of tonnes

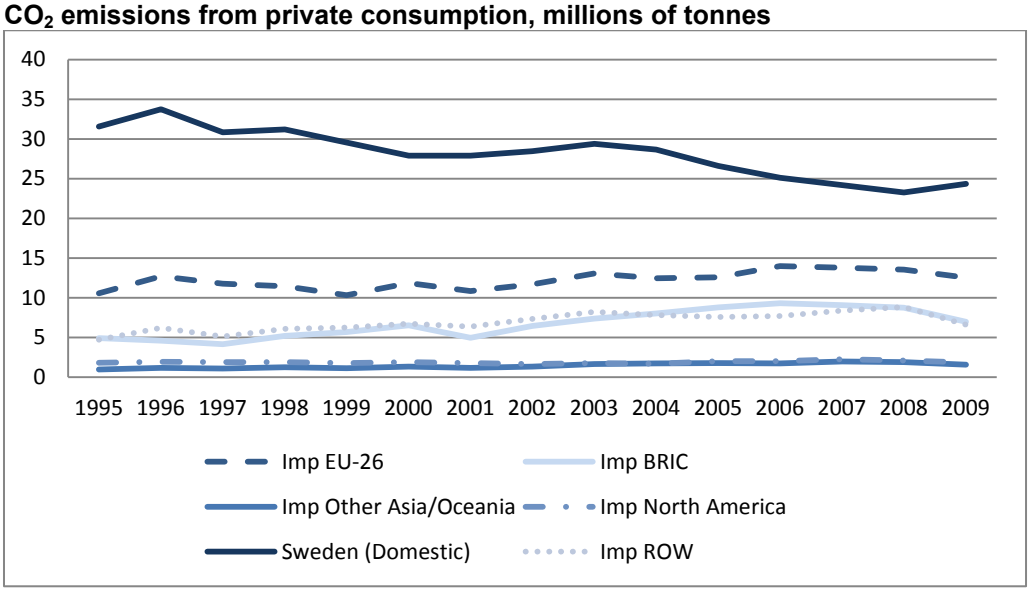


Source: WIOD, processed by Statistics Sweden

CO_2 emissions from private consumption were generated at the beginning of the period mainly in Sweden and to a lesser extent from imports. Emissions from imports increased during the period, however and became increasingly important for total emissions generated by private consumption. In 2009, the emissions from imports amounted to 55 percent of total emissions from private consumption while domestic emissions were responsible for 45 percent.

The regions that were responsible for the largest share of the emissions from imports generated by private households were EU-26, BRIC and other countries (RoW). The increase that can be seen from the beginning of the 2000s can to a large extent be linked to trade with China but also to trade with the majority of EU Member States, including Germany, Finland and the Netherlands.

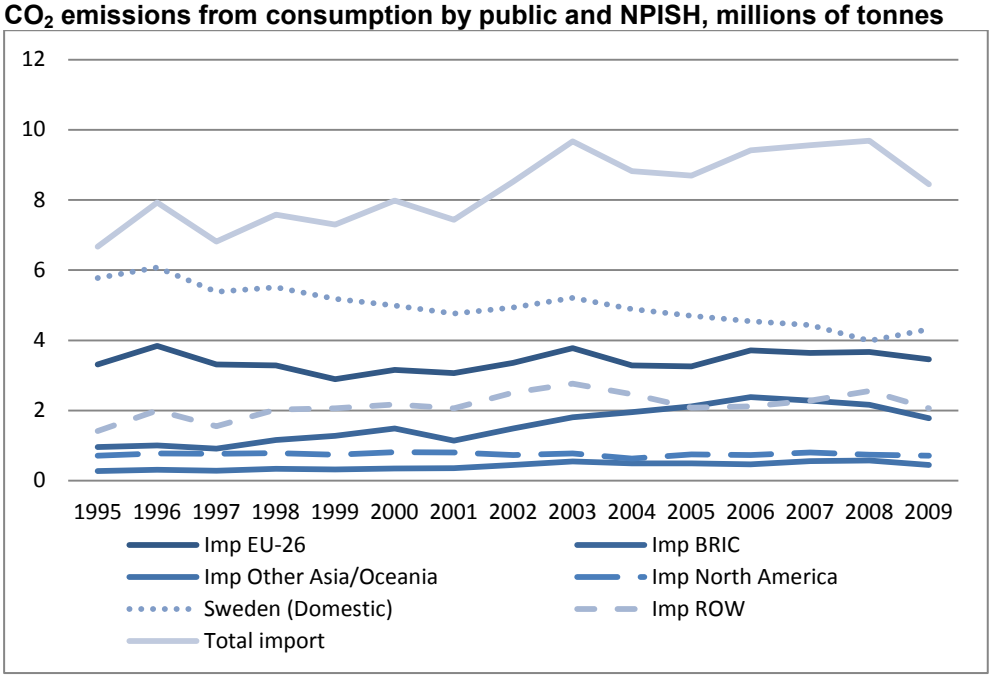
Figure 13
CO_2 emissions from private consumption, millions of tonnes



Source: WIOD, processed by Statistics Sweden

Throughout the period studied, CO_2 emissions from the public sector and NPISH were mostly generated abroad. This can probably be explained by the relatively large imports of pharmaceuticals and other medicinal products in the public sector. In 2009, the CO_2 emissions generated by imports made up 66 percent of total emissions from NPISH and the public sector, a share that was 54 percent in 1995. Even here, the CO_2 emissions were mostly generated in the EU-26 region during the period, followed by RoW and the BRIC countries.

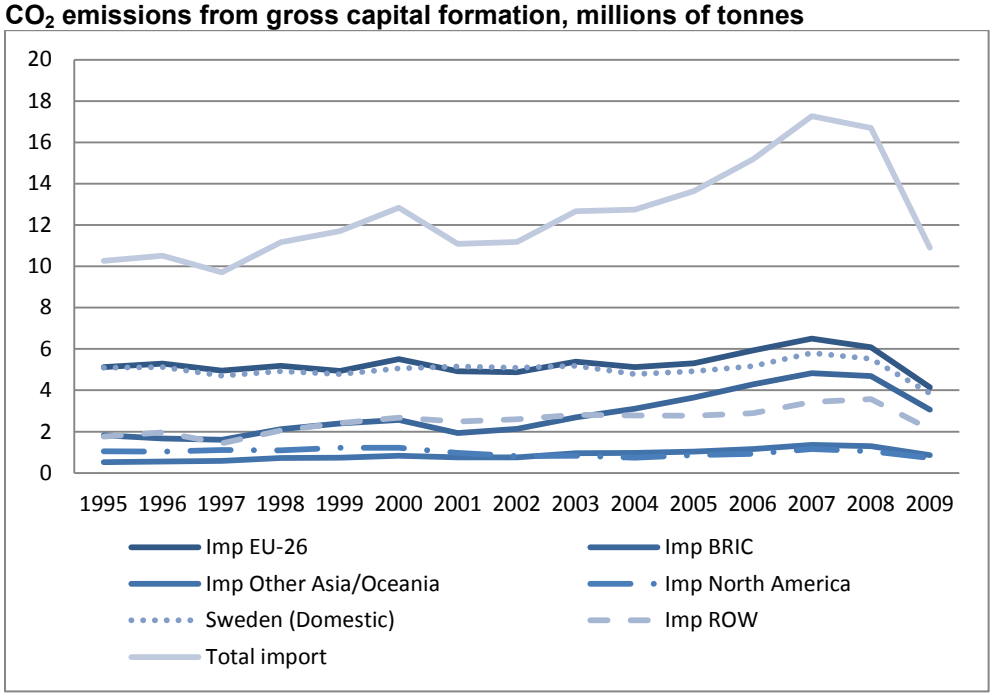
Figure 14
CO_2 emissions from consumption by public and NPISH, millions of tonnes



Source: WIOD, processed by Statistics Sweden

CO_2 emissions from gross capital formation were mostly generated from import activities during the entire period studied. In total, the import share of CO_2 emissions generated from gross capital formation amounted to as much as 74 percent in 2009. A clear increase from the mid-2000s can be seen here with a sharply downward trend during the crisis years of 2008-2009 — a pattern that can mostly be explained by trade with China and other countries (RoW).

Figure 15
CO_2 emissions from gross capital formation, millions of tonnes



Source: WIOD, processed by Statistics Sweden

3.4. CO_2 emissions from other regions

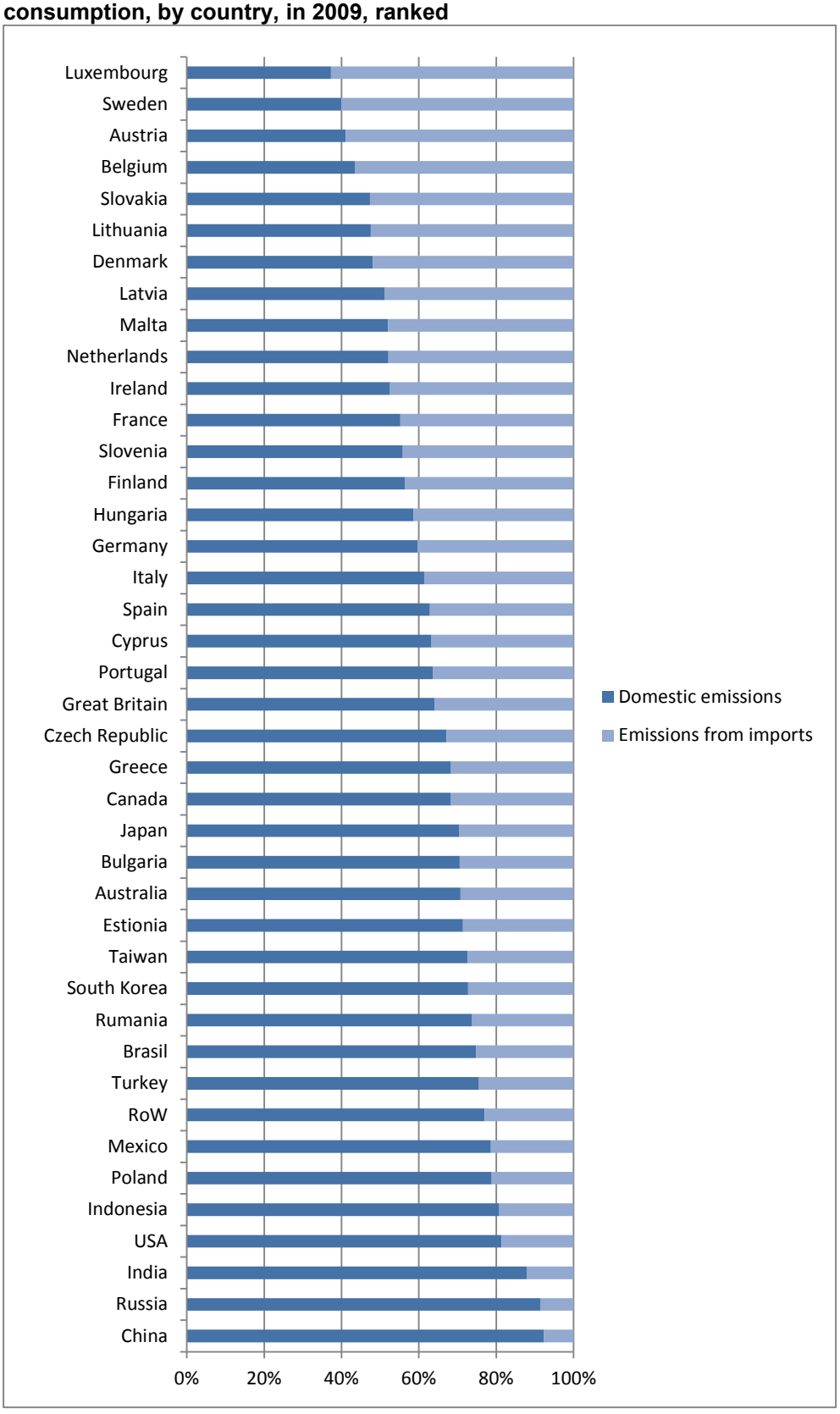
The following section provides a short introduction to how Sweden's CO_2 emissions from consumption have developed in comparison with other countries represented in the data.

Compared to other countries in the WIOD data, Sweden exhibits a relatively large share of imports for the total amount of CO_2 emissions from domestic consumption. This can partly be explained by the fact that the volume of domestic emissions of CO_2 is less than in many other countries. Small countries can be expected to have relatively large trade flows, which can also explain a part of the pattern.

Figure 16 shows the shares of all countries that can be linked to their emissions generated by imports and their domestic emissions respectively. The light blue bars therefore represent the share of the CO_2 emissions of the various countries that comes from imports, while the dark blue bars represent the share that can be linked to domestic emissions.

In 2009, Sweden's emissions from imports made up 60 percent of the country's CO_2 emissions per capita, which put Sweden in second place of all the countries represented in the data. This can be compared to e.g the United States, where 20 percent of the country's CO_2 emissions were generated by imports in 2009.

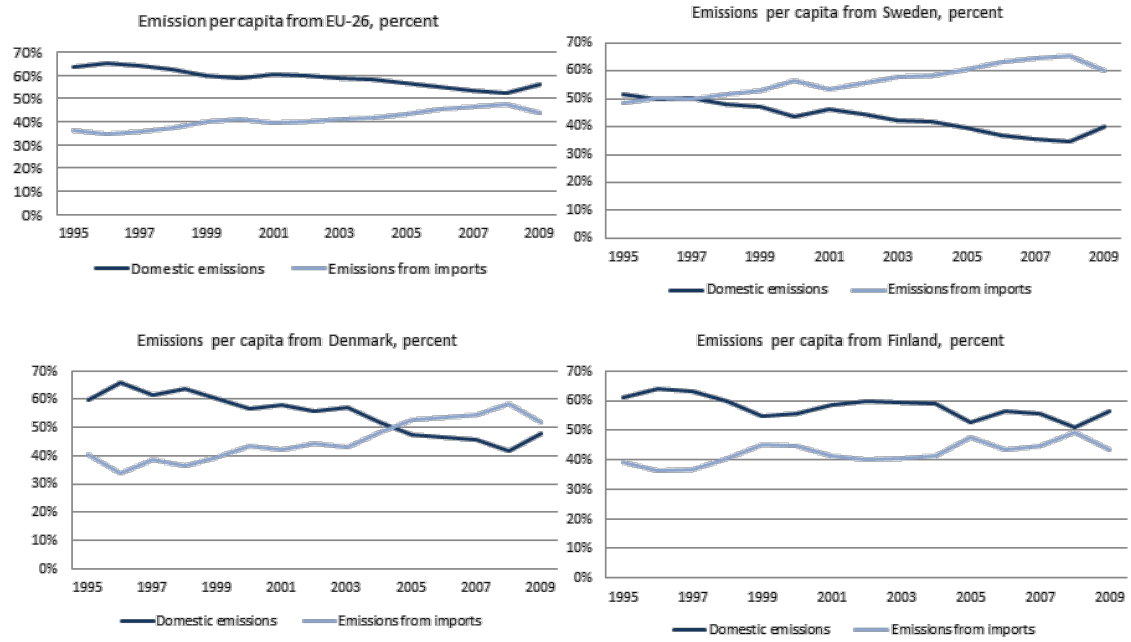
Figure 16
Percentage distribution of CO_2 emissions per capita from domestic consumption, by country, in 2009, ranked



Source: WIOD, processed by Statistics Sweden

As previously mentioned, the Swedish share of emissions generated by imports rose during the period studied. This pattern is not exclusive to Sweden, however. Similar increases can be found both in Europe as well as in other countries. Figure 17 shows how the share of emissions generated from domestic sources and from imports respectively changed for Sweden, EU-26, Denmark and Finland between 1995 and 2009. In all the regions selected, CO_2 emissions from imports are on the rise while domestic CO_2 emissions are on the wane.

Figure 17
CO_2 emissions per from Sweden and three selected regions



Source: WIOD, processed by Statistics Sweden

If we also include domestic emissions and look at total CO_2 emissions per capita from consumption in the various countries (measured as emissions from imports plus domestic emissions), we obtain the following picture of all the countries represented in the data.

Table 7
Comparison with other countries regarding CO_2 emissions, tonnes of CO_2 per capita.

	Emissions from imports per capita			Domestic emissions per capita			Import + domestic emissions per capita		
	-95	-09	Change	-95	-09	Change	-95	-09	Change.
EU-26	89	107	21%	157	139	-11%	246	247	0%
Sweden	5	5	16%	5	3	-27%	9	9	-6%
North America	7	10	41%	30	29	-3%	37	39	5%
BRIC	1	2	107%	12	14	20%	13	16	25%
Rest of Asia, Oceania	13	16	22%	37	40	9%	50	56	12%
RoW	0	1	38%	2	2	3%	2	2	9%
Total	114	140	23%	243	228	-6%	357	369	3%

Source: WIOD, processed by Statistics Sweden

As far as Sweden is concerned, total emissions measured per capita decreased by about 6 percent during the period, something which can mainly be explained by a sharp reduction in domestic emissions. A similar trend can also be seen for the majority of EU Member States during the period. It is also in the EU where the largest decreases in actual figures occurred, with Denmark, Germany and Luxembourg leading the way. For the EU-26 region as a whole, however, the total effect remains unchanged due to relatively high levels of emissions from imports from a number of countries.

For North America, total emissions from consumption increased by about 5 percent during the period according to this model. This can primarily be explained by a relatively strong increase in emissions from Canada and Mexico respectively. In the BRIC region, China was responsible for the largest increase, followed by India. These two countries were also responsible for the largest percentage increases of all the countries represented in the data. The country with the largest increase in actual terms is however Australia which increased its total emissions by 25 percent during the period studies, according to this model. It is also Australia that is the main reason behind the relatively strong increase in emissions from the rest of Asia /Oceania.

4. Discussion and future work

4.1. Possible improvements

The following section provides a short review of the possible improvements and in depth analysis of the area studied.

4.1.1. Longer time series

The data regarding environmental effects is only available during the period 1995-2009 in the WIOD database. This has unfortunately limited the analysis to this period only. Since the data for the national IO tables has been updated to 2001, a longer time period can be developed with the help of models. This would be of interest, as it would give us scope to study later years and the effect of the crisis years 2008-2009.

As an alternative to this, alternative databases and projects to WIOD can be studied. Examples of such projects are: Eora MRIO[10] and EXIOPOL[11].

Another possible route to longer time series is to examine the scope for further development of the Swedish IO tables. For example, trade statistics can be examined in order to highlight trade patterns between industries and countries as well as the transit trade that takes place in Europe.

4.1.2. Other possible improvements

To better understand what factors influence the Swedish development, it is interesting to take a closer look at analyses of explanatory variables, such as intensities, population, trade and economic development, etc. Sweden's presence in other countries, in the form of foreign investments and development assistance, is also of interest here. Furthermore, a closer study of the activities of different actors within Sweden's borders, such as tourists, private households and specific industries, is also worthwhile. An analysis of total greenhouse gases is also of considerable interest for the future.

Finally, a regional analysis of the consumption and emissions of Swedish counties is also of interest. Here, a regional IO model might possibly be coupled to a global IO model with the help of the rAps[12] analytical tool. This would give us the opportunity to understand more clearly the connection between what takes place locally in Sweden and Sweden's total environmental impact globally speaking.

4.2 How exports are dealt with in the statistics

It is however not just imports that influence our emissions in and outside Sweden. Our own exports also play a role. Many of the products produced in Sweden are exported and in turn used as inputs or final products in other countries. In terms of the multiregional input-output model, Swedish

[10] http://worldmrio.com/

[11] http://www.worldresourcesforum.org/files/file/WRF2011_Arnold_Tukker_PS2_19Sept.pdf

[12] rAps is a regional analytical and forecasting tool based on statistics broken down on the regional level. See http://www.tillvaxtanalys.se/sv/analysplattformar/regional-analys---raps.html

exports are reported in the recipient country. This means that they have been excluded in the results above as is described in the chapter on methodology.

Trade in products and services is multifaceted, however. The commodity or service exported by Sweden is used in different phases of production or final use in other countries. This means that in certain cases, these products come back to Sweden as finished goods or new inputs which in turn are used in the Swedish production process. Since the results presented in this report only cover Swedish CO_2 emissions from domestic final use (i.e. from private households, households' non-profit organisations, public consumption and gross capital formation) and hence exclude exports, these flows are not visible. The results reported above are therefore expanded below in order to include exports.

By including exports in the calculations, we therefore cover the emissions generated by all final use regardless of whether the product has been used inside Sweden or has been exported (and hence used by other countries).

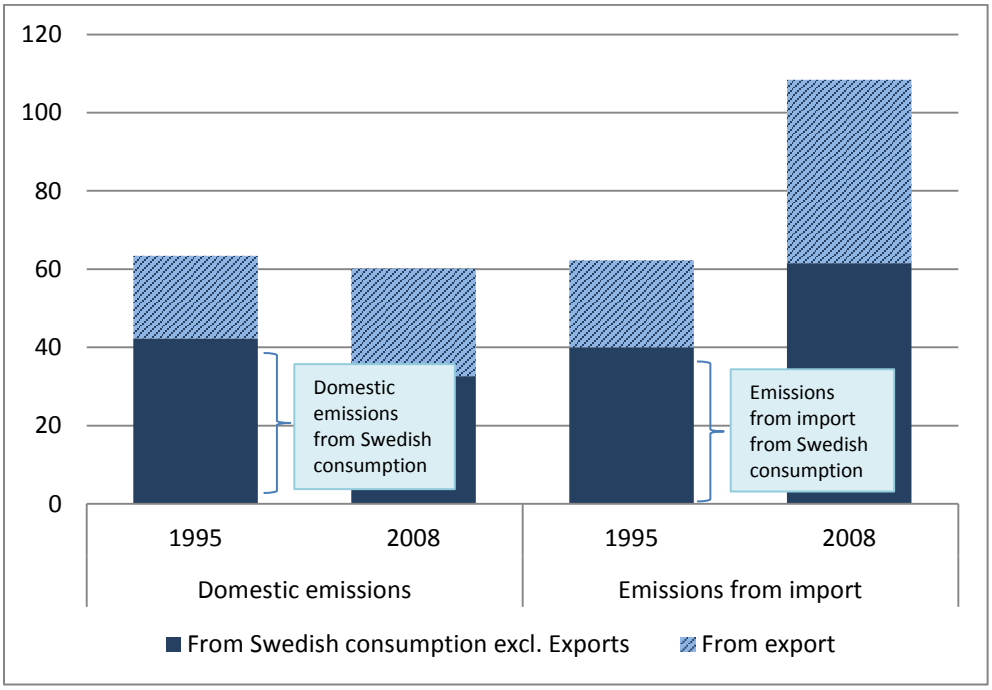
Figure 18 shows CO_2 emissions from a four-dimensional perspective. CO_2 emissions are first of all divided up into domestic emissions (generated in Sweden) and those generated from imports. And these two components are then divided up depending on whether the emissions are from Swedish consumption excluding and including exports respectively. Measured in accordance with WIOD, where exports are considered to belong to the consumption of other countries, domestic emissions from Swedish consumption amounted to about 32 million tonnes of CO_2 in 2008 while emissions from imports amounted to 62 million tonnes[13]. If exports are also included in the calculation, the emissions increase sharply and amount instead to more than 60 million and 108 million tonnes of CO_2 respectively in 2008. The most significant cause of the sharp increase is the part that consists of reimported components of exported goods and services.

Seen over the period studied, the export increment also gets bigger as trade becomes increasingly international. This means that the increase in emissions from imports that have been described previously in the report becomes even greater in this calculation. In total, the increase in CO_2 emissions from imports amounted to as much as 74 percent between 1995 and 2008 in this calculation, something which can be compared to an increase of 54 percent if the calculation is done in the same way as previously in the report.

In summary, this indicates that international trade seems to play a very important role when we try to understand what influences Swedish CO_2 emissions and that it is very important to clarify which parts of the Swedish economy ought to be included when we measure Sweden's total emissions of CO_2.

[13] Please note that the data are for 2008 and therefore differ from previously reported data which often refers to 2009. This is because WIOD uses SNI2002 (NACE rev 1.1)

Figure 18
CO_2 emissions in Sweden and abroad, including and excluding exports, millions of tonnes



Domestic emissions consist of emissions from Swedish production, broken down into exports of Swedish products (striped area) and emissions from Swedish consumption (fully shaded area), that can be linked to domestic emissions within Sweden's borders. **Emissions from imports** consist of both emissions from Swedish exports (striped area) and emissions from Swedish consumption (fully shaded area) that can be attributed to imported goods and services. The fully shaded area is the level that is reported earlier in the report while the striped area is the increment implied by the inclusion of exports.

Source: WIOD and the Statistics Sweden Environmental accounts

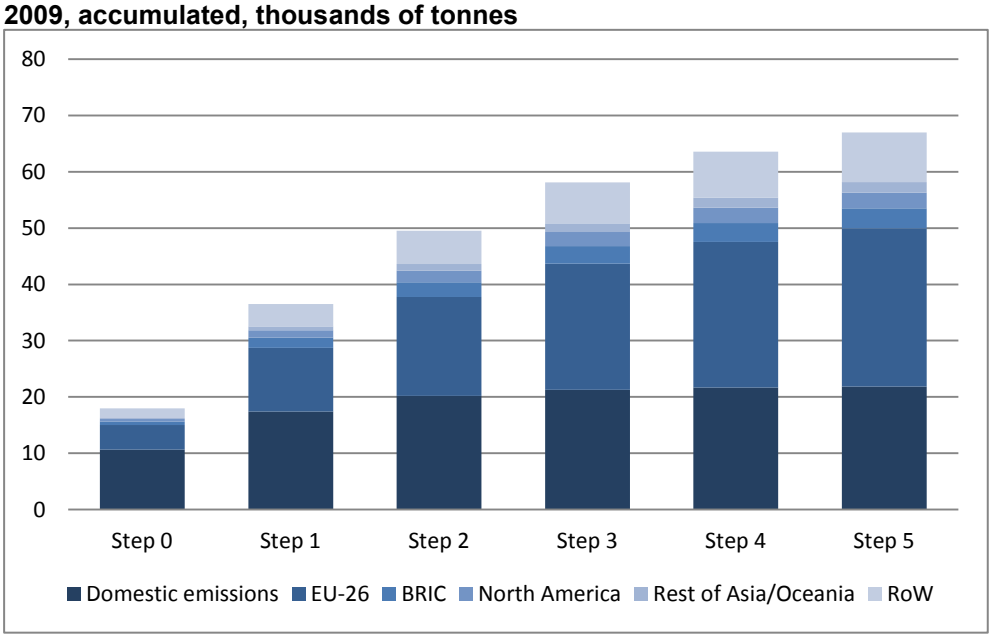
Appendix 1 - Global input-output production flow analysis

A brief description is given below of how a multiregional input-output model changes between different stages of production, from only including direct effects to reflecting the entire production supply needed to produce a certain commodity or service. This is in order to provide a better understanding of how a multiregional input-output model works and to show how imports affect Swedish emissions from consumption. The data is from WIOD and reflects Sweden's CO_2 emissions for 2009.

Figure 19 below represents Stage 0 - the CO_2 emissions generated by the production of a commodity or service in Sweden and in other countries. An example might be the production of a vehicle. Stage 1 represents the emissions generated by the input goods needed to be able to produce the commodity or service in question. In the above example, this might be the engine and body needed to produce the vehicle. This production can take place either in Sweden or abroad. If we follow this reasoning, the next stage represents the emissions generated in turn by these input goods, and so on.

The figure shows accumulated data for the first five stages in the production chain and the total effect for 2009. The data is then distributed based on whether the emissions are domestic or can be linked to imports, as well as which region the imports are from. The first five stages are shown here, as it is during these stages that the most significant changes occur. At later stages, the changes become less and less significant until they converge to zero.

Figure 19
Indirect CO_2 emissions in Sweden and from imports, by production stage, 2009, accumulated, thousands of tonnes



Source: WIOD, own calculations, excluding direct emissions

As can be seen in Figure 19, emissions generated by imports increase the most through the production stages. The largest increase can be seen between Stage 0 and Stage 1, where imports increase from 41 to 52 percent of the total CO_2 emissions from Swedish consumption. This increase means

that the share of emissions from imports comprises the majority of Swedish CO_2 emissions that can be linked to Swedish consumption. The increase between Stages 0 and 1 can primarily be explained by an increase from the EU-26 region, where Germany and Finland are major contributors. RoW and domestic emissions also increase relatively substantially between these two stages. Emissions from imports continue to rise sharply between Stages 1 and 2 while domestic emissions in Sweden seem to abate slightly.

Looking across all production stages, the share that can be linked to domestic emissions fell from 59 percent in Stage 0 to 30 percent after all stages will emissions from imports rose from 41 to 70 percent.

Appendix 2 - Industry codes and groupings

The following table describes which sub-industries are accessible in the WIOD data and how they have been aggregated in this report. The data is based on the international industrial classification NACE Rev. 1.1, which is equivalent to the Swedish classification SNI 2002.

Branscher tillgängliga i WIOD underlaget		**Använda branschaggregeringar**	
NACE rev.1.1	**Beskrivning**	**NACE rev.1.1**	**Beskrivning**
A-B	Jord- skogsbruk och fiske	A-C	Jord, skog, fiske och gruvor
C	Utvinning av mineraler	A-C	Jord, skog, fiske och gruvor
15-37	Tillverkningsindustrin	15-37	Tillverkningsindustrin
15-16	Livsmedel, dryckes- och tobaksindustrin	15-16	varav livmedel, dryckes- och tobaksindustrin
17-18	Textil och beklädnadsindustrin	17-19	varav textil- och beklädnadsindustrin
19	Tillverkning av läder och lädervaror	17-19	varav textil- och beklädnadsindustrin
20	Trävarutillverkning	20-23	varav trä, pappers och petroleumindustrin
21-22	Massa, papper, förlagsverksamhet och grafisk produktion	20-23	varav trä, pappers och petroleumindustrin
23	Stenkolsprodukter, raff. petroleumprodukter och kärnbränsle	20-23	varav trä, pappers och petroleumindustrin
24	Kemikalier och kemiska produkter	24-28	varav kemikalier, plast och mineralindustrin
25	Gummi- och plastvaror	24-28	varav kemikalier, plast och mineralindustrin
26	Icke-metalliska mineraliska produkter	24-28	varav kemikalier, plast och mineralindustrin
27-28	Metallframställning och metallvarutillverkning	24-28	varav kemikalier, plast och mineralindustrin
29	Tillverkning av maskiner	29-37	varav maskiner, transportmedel, övr. tillverkn. & återvinning
30-33	Tillverkning av el- och optikprodukter	29-37	varav maskiner, transportmedel, övr. tillverkn. & återvinning
34-35	Tillverkning av transportmedel	29-37	varav maskiner, transportmedel, övr. tillverkn. & återvinning
36-37	Övrig tillverkning, återvinning	29-37	varav maskiner, transportmedel, övr. tillverkn. & återvinning
E	El-, gas-, värme och vattenförsörjning	E	El, gas, värme och vattenförsörjning
F	Byggverksamhet	F	Byggnadsindustrin
50	Motorhandel	50-52	Handel
51	Parti- och agenturhandel	50-52	Handel
52	Detaljhandel	50-52	Handel
H	Hotell- och restaurangverksamhet	H, 64, J-P	Övriga tjänster
60	Landtransport	60-64	Transporter
61	Sjötransport	60-64	Transporter
62	Lufttransport	60-64	Transporter
63	Stödtjänster till transport, resebyråverksamhet	60-64	Transporter
64	Post- och telekommunikation	H, 64, J-P	Övriga tjänster
J	Finansiell verksamhet	H, 64, J-P	Övriga tjänster
70	Fastighetsverksamhet	H, 64, J-P	Övriga tjänster
71-74	Uthyrning av fordon och maskiner andra företagstjänster	H, 64, J-P	Övriga tjänster
L	Offentlig förvaltning, försvar, obligatorisk socialförsäkring	H, 64, J-P	Övriga tjänster
M	Utbildning	H, 64, J-P	Övriga tjänster
N	Hälso- och sjukvårds, sociala tjänster	H, 64, J-P	Övriga tjänster
O	Andra samhälleliga och personliga tjänster	H, 64, J-P	Övriga tjänster
P	Hushållens verksamhet som arbetsgivare	H, 64, J-P	Övriga tjänster

See separate word file for translation of table

Appendix 3 – Uncertainties

Multiregional input-output analyses are based on a number of more or less reliable statistical sources and assumptions and should therefore be used with caution and only be seen as a model. A short review of some of the uncertainties in the data follows below.

Supply and usage tables (SUT)

Since the supply and use tables that form the basis of the statistics are not available for every year, consistency over time has instead been created using other statistics.

Trade statistics

One uncertainty worth mentioning is the breakdown of the import matrices by country and industry that has been implemented by the WIOD project. Here, the WIOD project has used trade statistics to divide national use tables into domestic production and imports, and from which country the imports used in a particular industry originate. The fact that the information on the use by individual industries of imported and domestically produced goods and services is very difficult to access creates a major uncertainty in the data. This is further strengthened by the uncertainty regarding which country each individual industry imports from.

Furthermore, trade statistics have relatively good coverage for trade in goods but often much cruder and poorer coverage regarding trade in services. It can, for example, be difficult both to break down trade in services into type of service and country at the same time, something which adds further uncertainty to the data. Trade in goods between an EU Member State and a third, non-member country, can also be considered difficult to capture since trade flows can not only go directly between these two countries but also via another EU Member State. This creates uncertainty as regards which countries process the product and as regards where the emissions from imports are to be recorded. WIOD uses trade statistics from the UN COMTRADE database in combination with information on trade in services from different sources, including OECD, Eurostat, IMF and WTO. As regards trade statistics for goods, two approaches can be used to report the partner country for the imports. Either the country of origin or the last known country of despatch is reported as the partner country. It is most common to report the latter.

Statistics on air emissions by industry

Another uncertainty that should be mentioned is the air emissions data by country that has been used in the WIOD project. Put simply, two sources have been used to calculate air emissions. Firstly, industry-specific data according to Environmental accounts definitions have been used for many EU Member States, which means that only minor adjustments have been needed in the project. Secondly, data for other countries has been calculated with the help of e.g. energy balances and emissions factors from IPCC, which have hence needed to be adapted by the WIOD project.

Rest of the world

Another uncertainty is the calculation of the impact of other countries (RoW) and the handling of time series and gaps in the statistics. About 85 percent of global GDP could be covered by existing tables from national accounts around the world. A global IO table must however be balanced in the aggregate. The rest of the world must therefore be estimated in different ways. Regarding the RoW aggregate, it has been possible to use relatively good statistics for some countries (such as the EFTA countries Switzerland and Norway) while data for other countries has probably needed to be estimated. This has been done using a model based on totals for industrial output and final use that can be found at the UN and based on various assumptions. RoW is hence a balancing item for known data.

For more details on the methods chosen and data sources, please visit the WIOD project website: www.wiod.org.

References

EORA - http://worldmrio.com/

EXIOPOL - http://www.feem-project.net/exiopol/

Genty (2012) et al, "Final Database of Environmental satellite accounts: Technical report on their compilation", http://www.wiod.org/publications/source_docs/Environmental_Sources.pdf

Marcel P. Timmer (ed) (2012), "The World Input-Output Database (WIOD): Contents, Sources and Methods", WIOD Working Paper Number 10. www.wiod.org/publications/papers/wiod10.pdf

SCB, Miljöräkenskaperna www.scb.se/MI1301

Naturvårdsverket (2012), "Konsumtionsbaserade miljöindikatorer - Underlag för uppföljning av generationsmålet". http://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6483-9.pdf

Naturvårdsverket (2010), "Den svenska konsumtionens globala miljöpåverkan". http://www.naturvardsverket.se/Documents/publikationer/978-91-620-1284-7.pdf

Regional Analys och prognosmodell (rAps). http://www.tillvaxtanalys.se/sv/analysplattformar/regional-analys---raps.html

System of National Accounts 1993 (SNA 1993), https://unstats.un.org/unsd/nationalaccount/docs/1993sna.pdf

World Input Output Database (WIOD). www.wiod.org

The Environmental Accounts is an information system developed to systematically describe the connections between environment and economy. Statistics on environment and economy provide a foundation for calculations on costs of environmental measures and damages, analysis of environmental and economic policy as well as indicators on environmental status and sustainable development.

Report 2015:1 Carbon dioxide emissions from Swedish final consumption 1995–2009

This report describes the carbon dioxide emissions generated by Swedish final consumption within and outside of Sweden for the period 1995–2009. The analysis is based on the use of environmentally extended input-output tables together with information from the multiregional input-output database WIOD (World Input Output Database). Through the analysis it is possible to measure the emissions arising directly from the use of a certain good or service as well as the indirect emissions from previous steps in the production process.

Since 1998, the Environmental accounts report series has been published at Statistics Sweden. They are available on: www.scb.se/MI1301

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