

Do the new SNA 2008 concepts undermine Environmental Input Output Analysis?

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Abstract

The new SNA 2008 (UN, 2009) guidelines have led to changes in the recording of global manufacturing in national accounts worldwide. The 1993 SNA stipulated that exports and imports of goods should be recorded at the time ownership passes from a resident to a non-resident unit, but allowed for several exceptions to the ownership principle in case of merchanting, goods sent abroad for processing, and goods shipped to a foreign affiliate (UN, 1993). With the 2008 SNA these exceptions have been dropped in favour of the application of pure ownership criteria.

The 2008 SNA recommendations are to a large extent motivated by the need to ensure quality of statistics in a globalising world. These recommendations not only have major implications for the supply and use tables of the National Accounts (from 'gross' flows of goods to 'net' flows of services in case of processing), but also for input-output (IO) analysis.

This paper explains the theoretical consequences of the new SNA 2008 guidelines for IO analysis. Secondly, the paper quantifies the effect of the new 2008 SNA guidelines on footprint indicators by reversing the conceptual changes for global manufacturing in the Dutch 2010 after revision IO table and compares the outcomes. The main conclusions are that for the moment the effects are noticeable on the macro level but limited. At the meso level the outcomes differ significantly especially for manufacturing industries. These results bode ill for the future in which globalisation will most likely increase undermining the potential of environmentally extended input-output analysis.

Keywords: IO analysis, globalisation, 2008 SNA, merchanting, goods for processing, consumption based accounting.

JEL Classification Numbers: C67, E01, F64, P24

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1. Introduction

The System of National Accounts (SNA) is the internationally agreed standard set of recommendations on how to compile measures of economic activity (UN et al. 2009). In 2008 new SNA guidelines were adopted by the United Nations Statistical Commission. These new SNA guidelines (2008 SNA) have led to changes in the recording of global manufacturing. The 1993 SNA stipulated that exports and imports of goods should be recorded at the time in which ownership passes from a resident to a non-resident unit. However it noted four possible exceptions to the ownership principle: goods subject of a financial lease; goods shipped to a foreign affiliate; merchanting, and goods sent abroad for processing.¹ With the 2008 SNA these exceptions have been dropped in favour of the application of pure ownership criteria.

The 2008 SNA recommendations are to a large extent motivated by the empirical realities of a globalising world in which it becomes increasingly difficult to monitor production processes especially when supply chains are lengthening and the businesses involved are increasingly interconnected across multiple countries. As a result, the 2008 SNA has made the explicit choice to follow more closely business accounting practices where ownership concepts play a key role. In this way economic statistics are more compatible with economic reality and data collection is easier which in the end leads to a better quality of economic statistics. The downside is however, that a wedge has been driven between monetary and physical descriptions of the economy.

The 2008 SNA recommendations have major implications for the National Accounts, in particular for the recording of imports and exports, but also the recording of production and intermediate use, with the result that the input-output tables will also change. However, the recommendations also have a major impact on the environmental accounts (UN, 2014), especially concerning hybrid environmental indicators like emission-intensities and consumption based indicators which are based on input-output analysis.

The objective of this paper is to investigate to what extent the new 2008 SNA concepts undermine the ability to conduct Environmental Input Output analysis. The main novelty lies in the fact that we will quantify the effect of the new 2008 SNA guidelines on footprint indicators. This is accomplished by reversing the conceptual changes for global manufacturing in the Dutch 2010-after-revision-IO table. Subsequently, we compare outcomes for footprint analysis using both tables.

¹ The rationale for the first two exceptions was that although legal ownership did not change, economic ownership was effectively changed with the transferral of responsibilities and risks. Merchanting was recorded net in order to measure the value of the service the merchant provides. Processing was recorded net or gross depending on the extent in which the identity of the goods sent abroad was changed (with 3-digit CPC as criteria).

The outline of this paper is as follows. In section 2 we will briefly describe the 2008 SNA recommendations related to processing, deliveries between affiliates, merchanting and production abroad. In Section 3 we will discuss the implications of the 2008 SNA recommendations for various aspects of the environmental accounting system in particular environmentally extended input-output analysis. In Section 4 we discuss in detail on how we have reversed the conceptual changes in order to construct a reversed 2010-after-revision IO table. In Section 5 we present our results, followed by discussion and conclusions in Section 6.

2. The 2008 SNA recommendations

2.1 Goods sent abroad for processing (GSP)

The 1993 SNA stipulated that in case of goods sent abroad for processing (or goods sent to a foreign affiliate) a change of ownership had to be imputed even in case no change in legal ownership occurred. According to the revised 2008 SNA ownership transfer (or a product transaction) is leading without exceptions in determining how to record commodity import and export flows. This implies that goods sent abroad for processing are no longer automatically recorded as imports and exports in the National Accounts. However, they are – at least for now – still recorded in international trade statistics where as a general rule the cross border registration principle is followed. To clarify the issue upfront, let us consider the following realistic example for the Netherlands (Van der Holst and de Haan, 2010):

An oil refinery plant (the processor) – resident in the Dutch economic territory - converts 75 million € worth of crude oil into 100 million € worth of petrol. The crude oil is owned by a foreign parent company and shipped in from abroad. The foreign parent sells the petrol abroad. The oil refinery plant is receiving processing fees from the parent company to compensate for operational costs.

The differences between the 1993 SNA and 2008 SNA recording of this economic activity are illustrated in the table below. The 1993 SNA demands the imputation of a transfer of ownership. In this way the output of petrol and intermediate consumption of crude oil is explicitly covered in the production account of the oil refinery plant. The new national accounting guidelines do no longer allow this imputation and as a result imports of crude oil and exports of petrol are no longer recorded. Instead exports consist only of industrial services delivered to the owner of all products (crude oil and petrol).

Table 2.1 Global manufacturing: inward industrial processing

According to SNA 1993		
Output of petrol	100	
Intermediate use of crude oil		75
Value added		25
Import of crude oil	75	
Exports of petrol		100
According to SNA 2008		
Output of industrial services	25	
Value added		25
Export of industrial services		25

In theory, these new accounting conventions do not lead to a difference in value added or to different trade balance totals.² However, these new accounting conventions do lead to changes in the amount of production. In our example, production has been downwardly adjusted due to the new recording conventions.

The mirror situation in which the domestic economy sends good abroad for processing (outward industrial processing) is treated similarly. In this case, the domestic economy exports crude oil (intermediate use) and imports petrol (production) according to 2008 SNA concepts. A processing fee is imported.

2.2 *Merchanting*

Merchanting occurs when a resident buys goods from a non-resident, and sells these goods to another non-resident without these goods ever entering the economic territory of the resident.

A Dutch merchant buys 100 euro timber in Ghana from a Ghanese company and subsequently sells these for 120 euro to a Chinese company.

The 1993 SNA would record only the margins of the merchanter in our case 20 euro as export of services. In case of a strict application of the ownership principle, one should record imports of timber and exports of timber, where the margin would be a valuation layer balancing supply and demand. This would however result in major changes to total import and export values. Therefore, it was decided in the 2008 SNA to record the imports of timber as negative exports (in the example we would have a remaining positive export of 20 euro of timber).

² As argued in De Haan and van der Holst different ways of measurement (not based on imputed product flow values) of these activities may nevertheless lead to changes in outcomes.

During the revision process of the Dutch national accounts it was decided not to distribute the merchanting margins to underlying products within the balancing routines. The merchanting margins are considered as a separate product in the Dutch National accounts. At the same time, an estimate has been made for the value of imports and exports of goods that are subject to merchanting. The margin is however no longer recorded as an export of service, but is recorded as export of goods. There is therefore no effect on GDP, but the main implication is therefore on the respective trade balances goods and services. The values of these imports and exports need to be deducted from the 2008 SNA table, and the margin reinserted as the export of a service.

2.3 Production abroad (PA)

Production abroad occurs when a resident company has economic ownership of all the inputs and outputs of a production process, while the actual production takes place abroad. It differs only slightly from processing (and could also be considered a special case of processing), the main difference being that with production abroad both the inputs and outputs are usually bought and sold abroad (Van der Ende and Verbiest, 2011).

Notwithstanding the fact that the actual production process takes place abroad, according to the 2008 SNA accounting framework all the output is recorded in the domestic national accounts. Likewise, all inputs are recorded as imports, even though they most likely will not be recorded in international trade statistics. In general, production and intermediate consumption will increase as well as import and exports.

2.4 Deliveries between affiliated enterprises

In the case of deliveries between affiliated enterprises (mothers and daughters) the 1993 SNA by definition assumed a transfer of ownership in the case of border crossing. Using the new guidelines, this is no longer the case. Using the 2008 SNA one should first assess whether the resident group company is the economic owner of the goods or not (the degree of control over contracts, prices and quantities). In the case where the resident group company is not the economic owner of the goods one provides a service. In the opposite case, if the resident group company remains the owner of the goods, it is importing a service. It is assumed that the value of the service is broadly equal to the balance of the flow of the goods (GDP effect zero). Goods shipped to foreign affiliates result in similar adjustments as goods sent for processing.

3 Implications of 2008 SNA recommendations for environmental accounting (SEEA 2012)

The implications of the 2008 SNA are not confined to the national accounts only. From its inception, the SEEA (System of Environmental-Economic Accounting; UN et al. 2014) supplements the monetary transactions recorded in the SNA with descriptions of physical flows. For example, Economy Wide Material Flow Accounts describe the use of various types of materials (metals, energy, biomass) by the economy. With the new SNA guidelines, the monetary description of economic activity focusses primarily on changes in ownership and its subsequent financial settlement, at the expense of a focus on the actual production process (Van der Ende and Verbiest 2011).

Indeed, as the refinery example showed, a wedge is driven between the physical and monetary description of the economy (UN, 2011): from an economic perspective the refinery can indeed be portrayed as a service producer, but from a physical perspective it transforms crude oil into petrol, which is no longer reflected in the national accounts.

This issue was debated during the SEEA revision (Van Rossum et al. 2011) and was finally concluded (UN et al. 2014, para 1.36/1.43) as follows: *“Because it uses the same accounting conventions, the SEEA Central Framework is, in general, consistent with the SNA. However ..., there are some differences:”... in situations of goods sent to other countries for processing or repair, or in cases of merchanting, the SEEA Central Framework recommends recording the actual physical flows of goods...”*.

The choice for a physical description has severe implications for environmental accounting practices. It implies for instance that hybrid indicators like energy-productivity will differ dramatically depending on the use of the 1993 SNA or the 2008 SNA. Some of these issues may be avoided by using hybrid energy indicators on value added. The ramifications for environmental IO analysis, which is the main focus of our paper, are highly problematic. First and foremost, because the National accounts are no longer aligned with international trade in goods and services which exclusively follow a cross-border principle, trade linking practices are undermined. Second, it also implies that industries become less homogeneous in case processing occurs, which causes difficulties for the estimation of environmental extensions (Miller and Blair, 2009).

There appears to be three possible options to assure consistency of results of IO analysis:

- Adjust 2008 SNA IO tables by reversing the conceptual changes for global manufacturing.
- Separately identify production abroad and regular manufacturers in the IO table. The IO table would therefore obtain for such industries an extra row and column; each with their own emission coefficients.

- Alligning production boundaries for pressures (e.g. CO₂) and the economy in the case of production abroad

The first option has the advantage that it is consistent with the SEEA approach (describing physical reality). Moreover, by reverting the conceptual changes for global manufacturing, the imports and export data would be much closer to the values reported in international trade statistics.

The second option has as main advantage that it is consistent with the SNA. The main drawback however, would be that it requires splitting industries as well as making specific estimates of emissions caused by processors (resident / non-resident) and non-processors.

In this paper we explore the feasibility of following the first approach as it is in line with the SEEA CF recommendations.

4. Methodology

In order to quantify the empirical impact of the new 2008 SNA guidelines on global manufacturing and discuss its magnitude we want to compare the outcomes of using the 2008 SNA IO table, with an IO table in which conceptual changes for global manufacturing have been reversed. We have chosen the year 2010 as this was the year used for the 2008 SNA revision in the Netherlands.

4.1 Reversing global manufacturing in the IO table

In the beginning of 2014 Statistics Netherlands finished the SNA revision for the revision year 2010 (Statistics Netherlands 2014). As a result, the IO table based on the 2008 SNA concepts was compiled. Subsequently, this table was adjusted in order to reverse the new measures introduced by the 2008 SNA2008 concepts related to global manufacturing. The adjusted IO table records goods send for processing, deliveries between affiliates, merchanting and production abroad according to 1993 SNA concepts. All other SNA2008 conceptual changes (i.e. those not related to these specific issues) remain part of the adjusted table.

Adjustments of the 2008 SNA IO table are based on data gathered by the international trade division of the national accounts department. This division converts gross international trade flows of products (taken from the international trade statistics) into net service flows (processing fees) in case of processing. In case of production abroad, trade of goods are added to the international trade statistics data. In order to compile the adjusted IO table all changes made because of production abroad and goods send for processing had to be 'reversed'. This means gross trade of goods was added and the trade of services (as the net value of the imported and exported goods) was subtracted. If possible the adjustments were made without changing GDP. Finally, gross flows of merchanting, the purchase of goods by residents from non-residents where the resale of the same goods is to other non-residents without the goods ever having been present in the compiling economy, were removed from the 2008

SNA IO table. As a result the main changes in the IO tables relate to the import rows and export columns.

Table 4.1 Descriptive statistics- differences between the two IO tables (SNA 2008 vs adjusted table), 2010

	Relative difference in trade flows (SNA 2008 vs adjusted table)
	%

Export	-3,4
Import	-3,3

In Table 4.1 the extent of all the conceptual changes related to global manufacturing are shown (based on input-output tables 2010). In total, import and export are adjusted by 3.4 and 3.3 percent respectively³. The adjustments are very much concentrated in manufacturing. The differences presented in Table 4.1 represent the sum of all corrections related to processing, merchanting and production abroad.

5 Results

Table 5.1 -Descriptive statistics- Emissions embodied in final demand categories, difference 2008 SNA vs adjusted table

	Exports mln kg	Consumption government	Consumption households	Stock changes	Investment

Agriculture	-1	0	22	1	3
Mining & Manufacturing	-1131	2	280	-18	82
Energy companies and environmental services	2	0	4	0	2
Construction	17	0	3	0	222
Trade	13	0	8	0	1
Transport	95	1	154	0	14
Commercial and non-commercial services	13	85	106	0	18
Macro	-992	88	577	-17	343

For the year 2010 we have tested if and to what extent the new SNA 2008 guidelines have substantial impact on the results of IO analysis. For this purpose, we have chosen a 'simple' analysis where domestic CO2 emissions are attributed to final demand categories. The IO model used is explained in greater detail in Edens et al. (2011). It seems that at meso level (industry and product level) the impact is quite significant. However, at the macro level the impact seems less substantial, mainly because the

³ In the case of merchanting, gross flows are recorded in the Dutch input output tables.

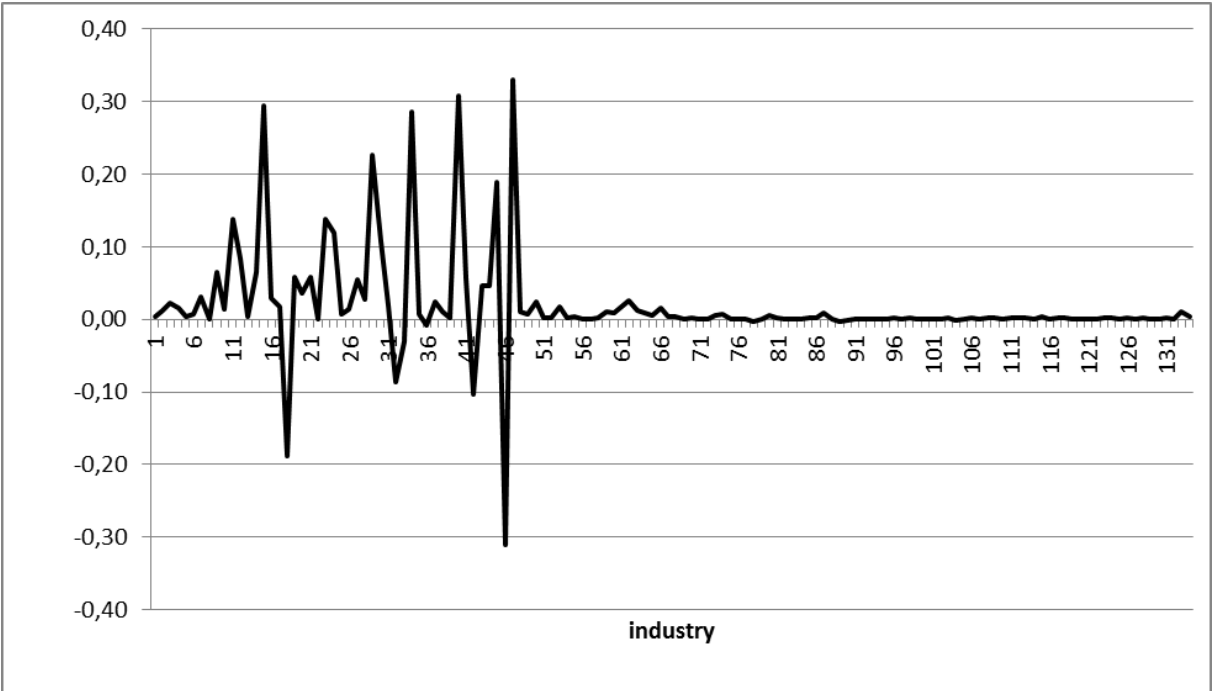
plusses and minuses at the meso level cancel out at the macro level. Altogether a shift of 1.15% from final demand towards exports occurs. These results can be explained by three factors:

1. The Leontief inverse has changed due to less homogenous industries

The different structure of the input-output table also affects the Leontief inverse and its corresponding multipliers. Not a single multiplier is unaffected when one replaces 2008 SNA IO-tables by the reversed table. The multipliers that are most affected are the multipliers of the industries that are most affected by the new SNA concepts, as depicted in Figure 5.1.

In general the manufacturing industries like the oil-industry, the chemical industry and tobacco industry are mostly affected. According to the SNA 2008 concepts these industries produce relatively more services and less goods.

Figure 5.1- Difference in output multiplier (backward linkage, euro) per industry (SNA 2008-adjusted table; from left to right: agriculture, industry, services (133 industries))



It is important to distinguish between backward linkages (the column totals of the Leontief inverse) and forward linkages (the row totals). Backward linkages indicate the effect an increase of output of industry *i* has on the required inputs from other activities, and therefore provide a measure of induced economic activity; forward linkages express the sensitivity of industry *i* to changes in outputs from other industries (Guo and Planting, 2000).

Figure 5.2- Differences in backward (vertical axis, euro) and forward output multiplier (horizontal axis, euro) for a few selected industries (size reflects output), SNA 2008 vs adjusted table, 2010

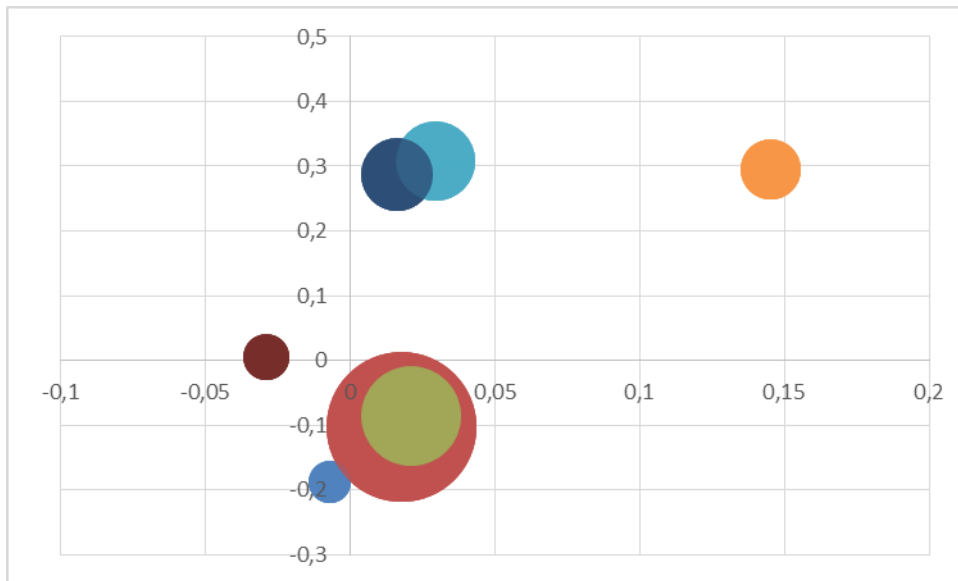


Figure 5.2 shows changes in forward and backward linkages for selected industries.

Electronics production (ISIC 26) and basic chemical products (ISIC 20) show large decreases in backward linkages and smaller increases in forward linkages. In the electronics production sector this is caused primarily by corrections for production abroad, which have led to significant downward adjustments for production and intermediate consumption during reversal.

Examples of activities that experience decreases in forward and backward linkages are manufacture of oils and fats (part of ISIC 10) and metal production (part of ISIC 25) and pharmaceutical products (ISIC 21). In case of oil and fats production, this is caused by corrections made for processing, which increases total output by this sector when reversing. The relative linkages with the domestic economy therefore decrease.

2. Recording of products (services versus goods) is not the same in between final demand categories

Emissions embodied in final demand are allocated to different final demand categories (by means of their corresponding share in total final demand per industry). Final demand is recorded differently per category using the rules of SNA 2008. Products with destination 'export' are valued less than products with destination 'consumption of households'. This results in less embodied emissions in 'exports' and more emissions embodied in 'consumption of households' and the other final demand categories.

3. Emission intensities have changed

Emission intensities are defined as emissions divided by production in IO analysis. Because production changes due to the new regulations emission intensities change too and become less homogenous. More globalisation probably will lead to less homogenous industries over time.

These three factors combined explain the different outcomes using SNA 2008 IO-tables instead of SNA 1993 IO-tables.

Figure 5.3 . Structural Decomposition Analysis of changes in embodied emissions due to reversing

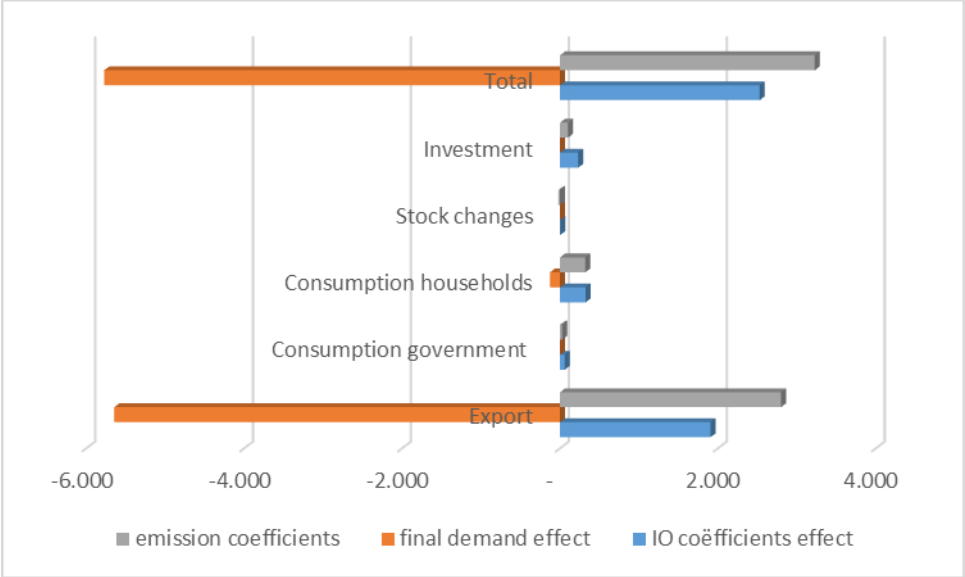


Figure 5.3 provides a SDA of the changes due to reversal of the three effects described above for each final demand category. The sum of the effects equals for each demand category the data presented in Table 5.1. As could be expected, the largest changes occur in the export column, as this column was modified most during reversal.

Overall, the final demand effect has a negative effect of almost 5.8 Mton CO₂, which is due to the overall decrease in the value of exports. This effect is offset by a positive emissions coefficients effect of 3.2 Mton and a positive change in structure effect of 2.5 Mton. The former is explained as reversing leads to lower exports and hence lower total output and hence higher emission coefficients by industries effected by reversal. The latter effect is likewise explained by changes in output.

5.3 Outcomes emission trade balance using SNA 2008 as well as reversed IO tables

Table 5.4 -Descriptive statistics- Emissions embodied in trade balance (SNA 2008 vs reversed table)

	Exports mln kg	Imports mln kg	Trade balance mln kg
Agriculture	-1	-244	242
Mining & Manufacturing	-1137	-3921	2783
Energy companies and environmental services	2	-989	991
Construction	17	2	15
Trade	13	44	-31
Transport	95	-26	122
Commercial and non-commercial services	13	67	-54
Macro	-998	-5066	4068

For the year 2010 we have also tested if and to what extent the new 2008 SNA guidelines have substantial impact on the outcome of the emission trade balance of the Netherlands. Embodied emissions in imports of the Netherlands differ substantially using 2008 SNA IO tables or reversed tables (- 8.4 per cent). This has also consequences for the emission-trade balance (+12.4 per cent). Again, the largest impact can be seen for mining, energy companies and manufacturing.

6. Discussion and conclusions

The main conclusion is that for the moment the new SNA 2008 concepts undermine Environmental Input Output Analysis to some extent. At the meso level (industry and product level) the impact is substantial. In particular the way in which transactions of emission-intensive manufacturing industries are recorded seems to affect the results. The effects are noticeable on the macro level but limited. This situation may change however in the (near) future, when globalisation continues its current course, this will most likely increase the predominance of the phenomena discussed here.

The 2008 SNA guidelines on global production affect the results of environmental IO analysis. The assumption that activities in industries are homogenous is an important assumption in carrying input-output analysis (Miller and Blair, 2009). This assumption is under further pressure because industries become less homogeneous due to the new guidelines.

A response from the IO community is needed to deal with these challenges. The reversal option investigated here proved not too difficult to implement and may be of interest to other researchers. The alternative would be to split up industries to differentiate between processors and non-processors. We believe that this option is more difficult to implement, due to the fact that it would require emissions

data to be available at enterprise level. Moreover, this option would also substantially increase the size of IO tables, and pose additional challenges when trade linking.

The results obtained here were due to usage of a simple IO model (domestic technology assumption), in future research we intend to analyse the changes also in an MRIO setting.

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