EUROPEAN COMMISSION
EUROSTAT

Directorate E: Sectoral and regional statistics
Unit E-2: Environmental statistics and accounts; sustainable development

Material flow accounts in raw material equivalents

Eurostat

London Group on Environmental Accounting

Meeting of 17 to 20 October 2017
Costa Rica

***Abstract**: Material flow accounts in raw material equivalents (MFA-RME) complement economy-wide material flow accounts. MFA-RME account for products in terms of the amount of domestic extraction necessary to produce them, irrespective of where the material was extracted. Producing those estimates is closely related to input-output techniques, which is one of the elements in the SEEA CF research agenda. The main MFA-RME indicator, raw material consumption (RMC), is also referred to as a 'material footprint', as it captures the amount of extraction of materials needed to meet the country's consumption and investment demand. There is substantial policy interest in MFA-RME in Europe, both from EU and national policy makers.*

This paper will report on several Eurostat activities. First, Eurostat has developed a model to estimate MFA-RME for the aggregated EU28 economy; results have been published since several years. Secondly, Eurostat together with experts from European countries have developed a technical note that aims at clarifying the treatment of secondary materials in the trade parts of MFA-RME. Thirdly, Eurostat has developed an RME tool for producing country estimates as a way of assisting countries who wish to start estimating MFA-RME. Fourthly, Eurostat is promoting and co-ordinating an EU-wide data collection of MFA-RME by the end of the year. This data collection will piggy-back in the existing EU MFA data collection, which is in place for several years.

This paper will report progress and seek a discussion by the London Group on these matters.

1. Introduction

'Material footprint' is the layman's term for an indicator expressing the production-chain-wide global material resource requirements attributable to a country.

Under the label of *'material flow accounts in raw material equivalents (MFA-RME)'* the European Statistical System has started to work on (1) the statistical conceptualising of 'material footprint'-type indicators and (2) related compilation methods. Political demand for a 'material footprint' indicator has been articulated in the context of the European Union's resource efficiency initiative. Two indicators for Sustainable Development Goals are about 'material footprints' (8.4.1/12.2.1).

This paper presents an overview on related activities coordinated by Eurostat.

Questions to the LG about the methodological choices in Eurostat's EU RME model:

- How bad is the adjusted DTA when you have nothing else better?
- Could you think of any alternative methodological approaches to estimate material flows in raw material equivalents?
- Would you have any recommendations on how to improve the EU RME model?

Question to the LG about establishing an 'official' global multi-regional input-output table (MRIOT) extended by domestic extraction of materials:

- How could the LG contribute to such a process?

2. Conceptual framing – towards statistical definition of *'material footprint'*-type indicators

The System of Environmental-Economic Accounting 2012 – Central Framework (SEEA2012-CF) does not mention nor provide any statistical definition of *'material footprint'*-type indicators. Moreover, another SEEA publication refers to it: the System of Environmental-Economic Accounting 2012 – Applications and Extensions (SEEA2012-AE) introduces the terms *'footprint indicator'* and *'consumption based indicators'* (paras 2.51 – 2.54, and 3.45 – 3.59). Another definition can be found on UNSD's website on SDG.

In the European Statistical System the term ***'material flow accounts in raw material equivalents (MFA-RME)'*** was introduced to emphasise that one may consider a wider accounting framework behind the layman's term *'material footprint'*. The rationale of MFA-RME is to express the final use of products in equivalents of material extractions (=raw material equivalents). This means the material extraction worldwide (domestically and in the rest of the world) that was necessary to produce and make available the respective products to final use in a national economy.

One key consumption based indicator derived from MFA-RME is the raw material equivalent of total final use (= final consumption expenditure + gross capital formation + exports). It is termed *raw material input (RMI)*.

One may argue that the raw material equivalents of exports should not go on the account of the reporting country. Hence another – more prominent – key consumption based indicator is defined as the raw material equivalent of products used for domestic final use (= final consumption expenditure + gross capital formation). It is termed *raw material consumption (RMC)*.

Above definitions of *RMI* and *RMC* are based on a typical national accounts' perspective where the final use of products is regarded as the ultimate goal of economic activities.

Both indicators can be defined slightly differently (and maybe more simply), taking a perspective similar to the arithmetic of indicators derived from *economy-wide material flow accounts (EW-MFA)*:

RMI = domestic extraction + imports in raw material equivalents

RMC = RMI – exports in raw material equivalents

Summary overview of Eurostat activities concerning conceptual framing:

- A section on MFA-RME has been added to the forthcoming Eurostat handbook on economy-wide material flow accounts (EW-MFA). Publication is planned for end 2017.
- The Eurostat task force on material flows discussed several conceptual questions related to MFA-RME. Task force documents including minutes are archived on the CIRCABC platform (https://circabc.europa.eu/w/browse/5074c555-99ea-4931-ace8-9351fa174f8b).
- In close consultation with the task force on material flows, Eurostat drafted a methodological paper on treatment of secondary raw material in MFA-RME (can be provided on request).

3. Estimating material flow accounts in raw material equivalents (*MFA-RME*)

There are various methods for the compilation of *'consumption based indicators'*. The most appropriate method is the Leontief-type input-output (IO) modelling using a global, environmentally extended multi-regional input-output (MRIO) table. This method is fully coherent with principles and concepts of national accounts in the way it assigns material extractions to the final use of products. The method has been refined and applied by several research projects to estimate *'material footprints'*-type indicators. Results vary considerably, mainly due to different resolutions of MRIO tables.

Data requirements for this method are enormous. In the case of material flows, the global MRIO table requires a detailed industry breakdown, particularly for the mining and basic manufacturing industries. So far, the global statistical system has not been able to set up a global data base of environmentally extended MRIO tables. OECD and Eurostat launched a cooperating on this.

Since a couple of years, Eurostat estimates and publishes MFA-RME for the aggregated EU economy. The results are published on Eurostat's online database.

Due to the lack of a global MRIO table provided by 'official statistics', Eurostat developed its own European model: the EU RME model. It is a specific model which has been denoted ADTA-IO model (adapted domestic technology assumption input output-model). The core of the model forms a single region IO table for the aggregated EU economy with a quite detailed product breakdown (182). The IO table is hybrid, i.e. use structures for goods are in physical units whereas use structures for services remain in monetary units. The documentation of the EU RME model can be downloaded from Eurostat's website.

The model applies widely the 'domestic technology assumption' (DTA) for estimating the raw material equivalents (RME) of those imported goods and services for which production also takes place in Europe. Assuming European production technologies is obviously a drawback and hence the DTA is adjusted:

- Revaluation of imports at domestic prices
- Regionalised information for estimating recycling ratios for indirect metal imports
- Regionalised information for estimating the energy mix of direct and indirect imports of electricity

As regards imports of goods which are not produced in the EU economy the model is supplemented by external information, which is partly based on life cycle inventory (LCI) data

The main characteristics of the Eurostat's EU RME model are as follows:

- Adapted domestic technology assumption input-output model.
- Hybrid IO tables.
- Extended with life cycle inventory data.
- 182 products; added detail mostly in agriculture (CPA A0), mining (CPA B), food products (CPA_C10-12) and metal products (CPA C24).
- Structural information for the additional sectors from a detailed German IO table for 2010.
- The hybrid detailed IO tables are consistent with data from national accounts at the NACE A*64 aggregation level.

Main modelling steps are the following:

- Establishing an annual high resolution monetary IO table by expanding the monetary EU-level standard IO table 64x64 to the size of 182x182.
- Establishing a high resolution hybrid IO table. The high resolution monetary IO table is converted into an IO table with mixed units by inserting physical sales structures for selected product groups.
- Collecting and disaggregating (only for metal ores) data on domestic extraction
- Estimating the RME of imports of metal ores and basic metal products based on external regionalised information.
- Leontief inverse based on the DTA/LCI (metals), 1st loop.
- Revaluation of imports at domestic prices.
- Adding further regionalised information on metal recycling ratios and primary metal content of indirect metal imports.
- Adding further regionalised information on the energy mix of electricity generation.
- Leontief inverse based on the adjusted matrix for the RME of imports, 2nd loop, final results for RME 2008 and onwards.

So far, only a few national statistical institutes in Europe compile MFA-RME estimates at country level. Since 2017 Eurostat collects MFA-RME data from countries on a voluntary basis (via its annual EW-MFA questionnaire). Eurostat provides an IT compilation tool to national statistical institutes ('country raw material equivalents (RME) tool'). The tool and an associated handbook are available on Eurostat website.

4. Conclusion/outlooks: fitting into the grander scheme of global SEEA harmonization

In order to meet policy demand Eurostat has started to estimate material flow accounts in raw material equivalents (MFA-RME). Eurostat publishes estimates for the aggregated EU and expects that some European countries will submit estimates too for central publication by Eurostat.

An 'official' global multi-regional input-output table (MRIOT) extended by domestic extraction of materials would be the 'perfect' single data base for estimating 'material footprints' for all countries on the world, including those assembled in the European Statistical System (ESS).

Due to the lack of such a global MRIOT Eurostat is currently using its own EU RME model and providing a simplified tool to countries for their national estimates.

The London Group could contribute to the discussion on how to establish an 'official' global multi-regional input-output table (MRIOT) extended by domestic extraction of materials.

References

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