Empowering Carbon Accounting: From Data to Action

People and perspectives meet: an international workshop on carbon content measurement

Ulf von Kalckreuth, Deutsche Bundesbank, DG Statistics

Conference of European Statistics Stakeholders (CESS) 2024, Paris, 15.10.2024

I thank my co-authors:

Alessandra Alfieri, International Monetary Fund (IMF)

Lauren Holloway, E-liability Institute (ELI)

Stephan Moll, Eurostat

Christian Schmieder, Bank for International Settlements (BIS)

Bruno Tissot, Bank for International Settlement (BIS)

Why are central banks interested?

Climate change is a **risk** – for everybody, but also for financial stability.

- **Physical risk** – from the physical asepcts of climate change: heat stress, wildfires, thunderstorms, water stress, sea level rise
- **Transition risk** – the transition to a low carbon economy will put an end to the business model of firms that cannot adapt.

For capital market participants, the systemic components of these risks are **external effects**. They should enter into the pricing of finance and regulatory standards. With other types of risks this is being carried outh through capital requirements (eg Basel accord).

Why are central banks interested?

- Network of Greening the Financial System: an association of most central banks world-wide, co-ordinating and exchanging work on sustainability issues
- **Very active research work** in most business areas of central banks: Financial Stability, Banking Supervision, Economics, Statistics
- The Bundesbank has set up a **new Directorate General on sustainability issues**

- The Statistics Departments in the Eurosystem are setting up a new range of experimental statistics, monitoring the emissions financed by the banking system

Central banks as well as other policymakers are yet **missing reliable activity data** on which policy action could be based.

Carbon content measurement for products, organisations and aggregates: creating a sound basis for decision making

International workshop organised by the IMF, the BIS/IFC, Eurostat, the Deutsche Bundesbank, the Banco Central de Chile and the University of Oxford Blavatnik School of Government

21-13 February 2024, Hamburg, Germany

[Link to conference website, incl presentations]

Workshop participants

- In Hamburg more than 60 live representatives from
  - international organizations, central banks, ministries, ESG reporting standard setters, statistical offices, corporate accountants, data platform providers, satellite data providers, EU Commission, enterprises, universities
  - six continents (the Americas counting as two)

- More than 200 registered virtual participants worldwide

Consistent results and findings from all participants.

"Only what gets measured, gets managed" (Bo Li)

Reliable and readily available measures of **carbon content** enable

- **Companies** to align their production processes in a climate-friendly way,
- **Investors** to direct their capital towards climate-friendly investments if they wish,
- **Banks** to better assess the climate risks in their portfolios,
- **Governments and regulators** to intervene if necessary, and
- **Consumers** to better understand the consequences for the environment of their decision to purchase a particular product or service.

Carbon content information is a **necessary condition** for **rational,** environmentally-oriented **decision making.**

"Only what gets measured, gets managed" (Bo Li)

Carbon content information is produced and needed on three levels:

- **Aggregate level -- country and sector** **statistics**
- **Company level** **non financial reporting**
- **Product level** **carbon accounting**

As yet, measurements and measurement concepts are unrelated. There is **no joint framework, no cross-validation**, no way to use data from one level to **fill data gaps** in the other.

"Only what gets measured, gets managed" (Bo Li)

Carbon content information is produced and needed on three levels:

- **Aggregate level -- country and sector** **statistics**
  G 20 Data Gaps Initiative (DGI), ECB ESG climate indicators
- **Company level** **non financial reporting**
  ISSB Standards, EU Legislation, specifically CSRD and ESRS
- **Product level** **carbon accounting**
  industry initiatives (chemical industry, automobiles), accounting research

As yet, measurements and measurement concepts are unrelated. There is **no joint framework, no cross-validation**, no way to use data from one level to **fill data gaps** in the other.

Direct and indirect emissions and total carbon content

Consider the *bill of material* (BoM) of product *k*, with $a_{k,i}$ being the quantity of good *i* embodied in the production process:

$$\mathbf{a}_k = (a_{k1} \quad a_{k2} \quad \dots \quad a_{kK})'$$

Let d_k be the amount of GHG directly emitted and c_i be the carbon content of input *i*

direct emissions

indirect emissions

valuation structure of inputs

Then the carbon content of *k* is given as the **sum of direct and indirect emissions**:

Carbon content vector

$$c_k = d_k + \mathbf{c}'\mathbf{a}_k = d_k + \sum_i c_i a_{ki} \qquad (1)$$

quantity structure of inputs

If the c_i are known, we can calculate the carbon content of product k directly.

The hen and the egg problem

What if we do not know the carbon content of our inputs?

Three answers:

- Try to understand your value chain and quantify direct emissions on each stage, then sum up

  Drilling down the value chain: The tao of the GHG protocol

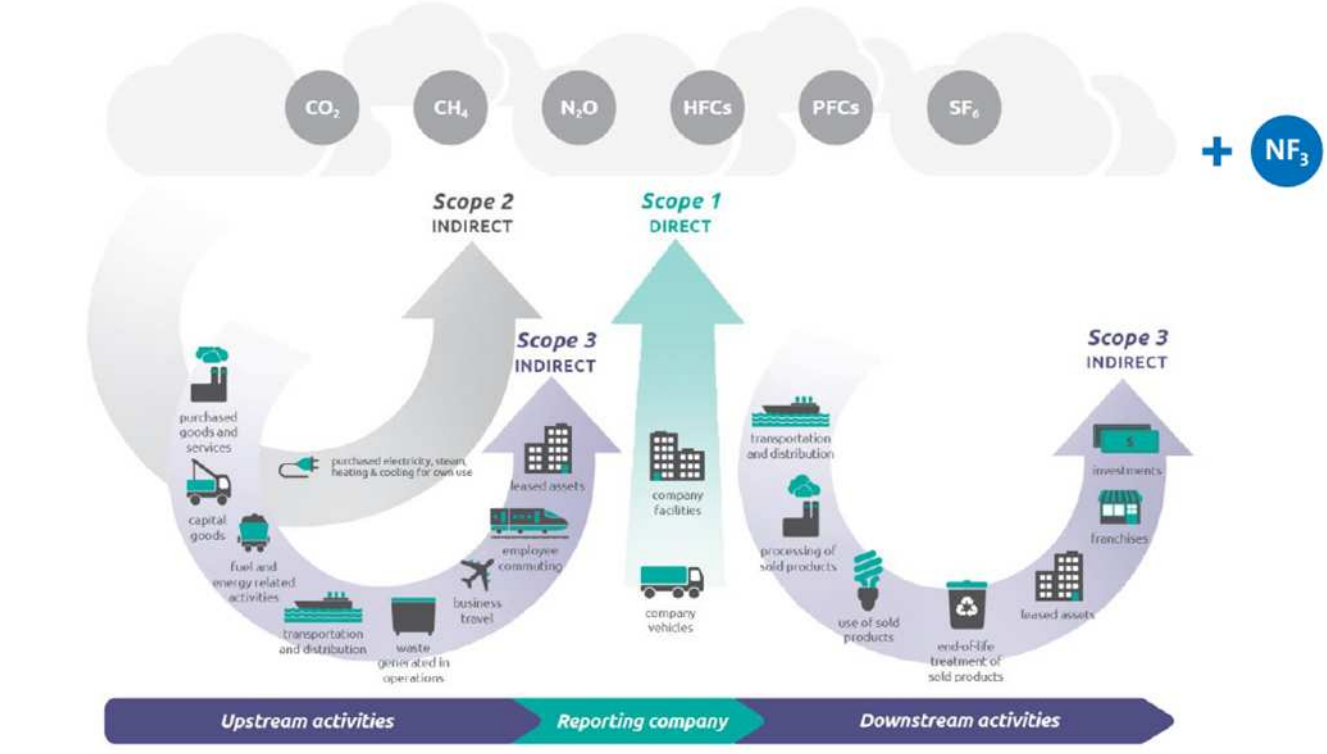
- From knowledge of input requirements, solve for carbon content of all products in the system

  Explicit knowledge: The tao of IO

- Make your input provider give you the required information

  Implicit knowledge: The tao of cumulative carbon accounting

The tao of GHG Protocol



Source: Greenhouse Gas Protocol (2011): *Corporate value chain (Scope 3) accounting and reporting standard.*

GREENHOUSE GAS PROTOCOL

The tao of IO

If the c_i are unknown, the equation is **recursive**. Equation (1) is an **IO model for production**. We can solve for the GHG value of all products simultaneously. Let

$$\mathbf{A} = (\mathbf{a}_1 \quad \mathbf{a}_2 \quad \dots \quad \mathbf{a}_K)$$

be the matrix of the BoMs for all produced goods. With **d** the vector of direct emissions for products 1,…, *K*, we may write:

$$\mathbf{c}' = \mathbf{d}' + \mathbf{c}'\mathbf{A}$$

This is how actual IO works using industry level data from different countries.

and solving for **c** yields

$$\mathbf{c}' = \mathbf{d}'(\mathbf{I} - \mathbf{A})^{-1} \qquad (2)$$

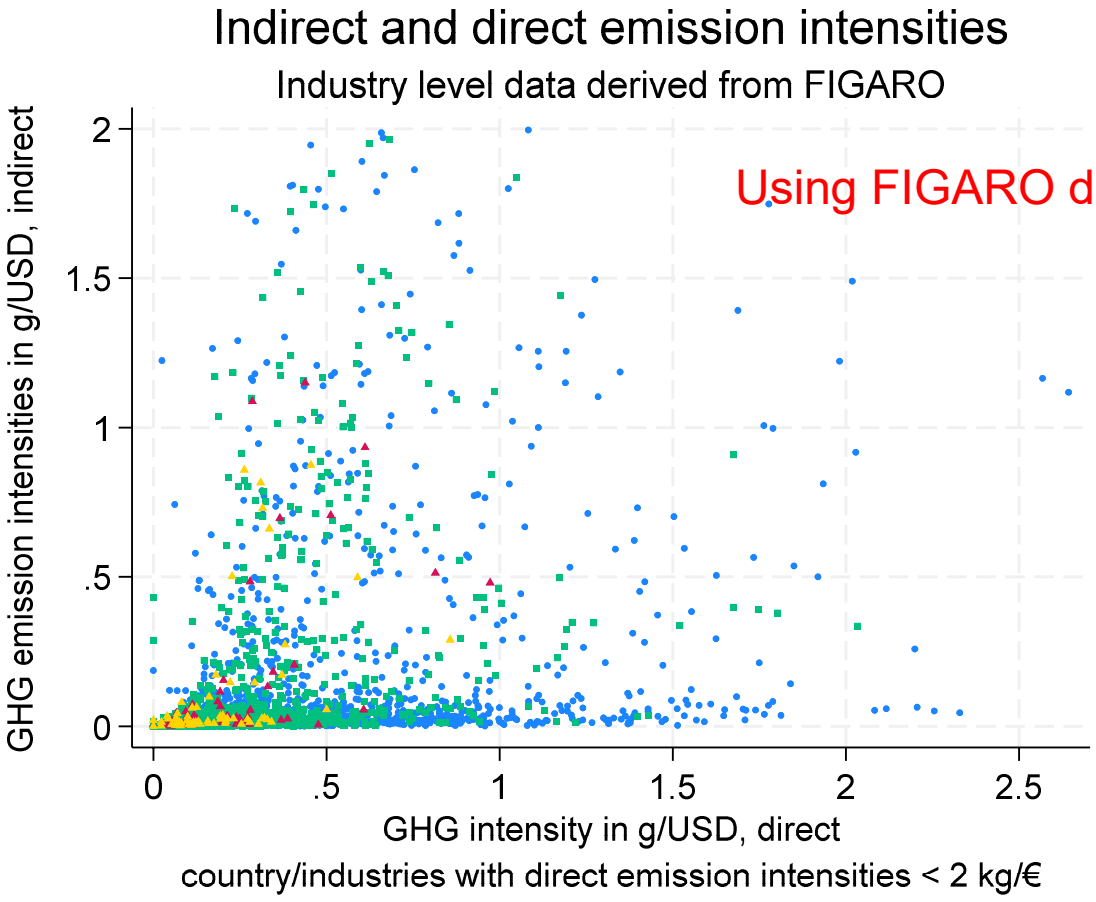
It shows how the carbon content of products is derived from direct emissions and interlinkages

Carbon contents of all goods

Direct emissions for all goods

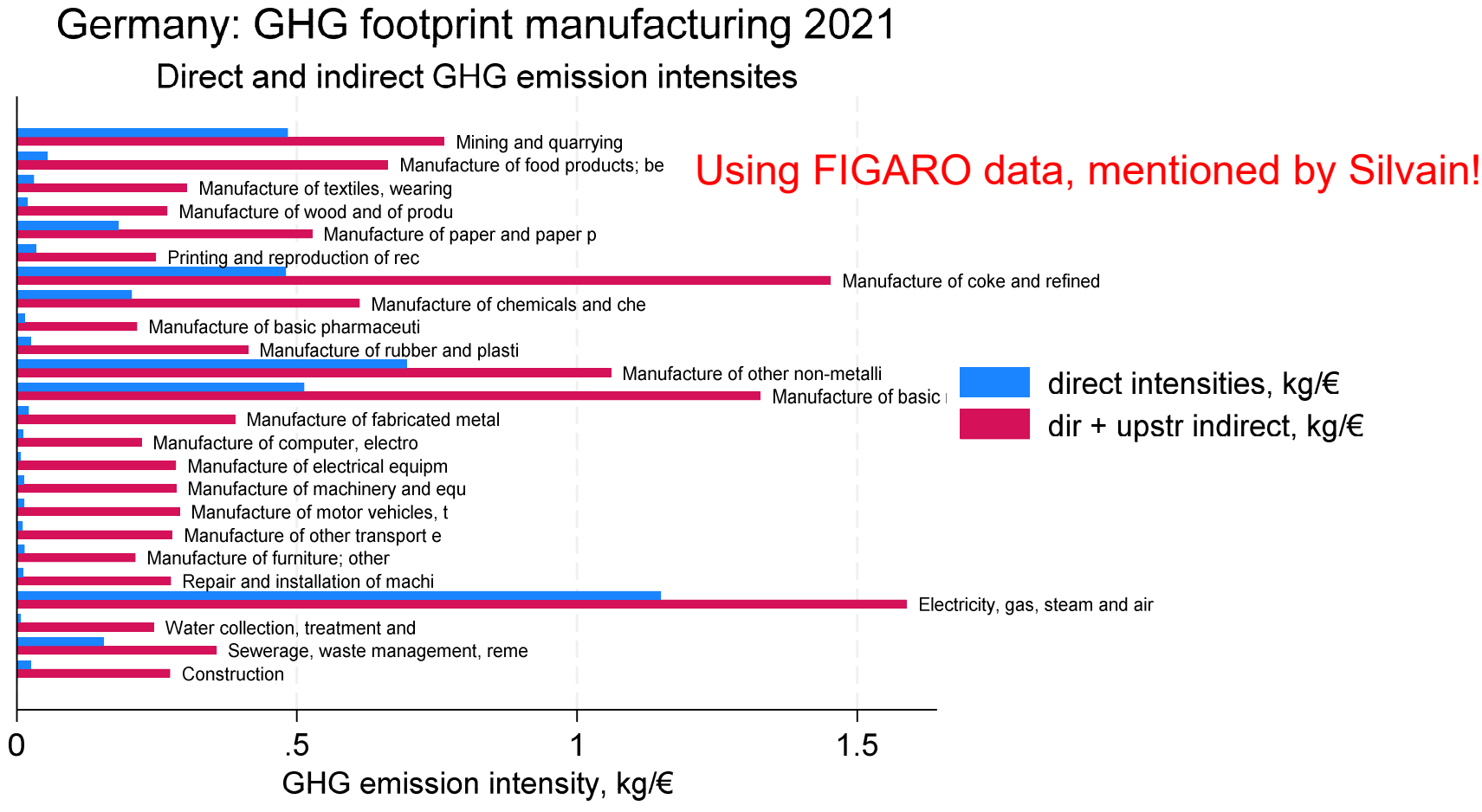
Leontief inverse, reflecting production interlinkages

The tao of IO



Using FIGARO data, mentioned by Silvain!

The tao of IO


Germany: GHG footprint manufacturing 2021
Direct and indirect GHG emission intensites
Mining and quarrying
Manufacture of food products; be
Manufacture of textiles, wearing
Manufacture of wood and of produ
Manufacture of paper and paper p
Printing and reproduction of rec
Manufacture of coke and refined
Manufacture of chemicals and che
Manufacture of basic pharmaceuti
Manufacture of rubber and plasti
Manufacture of other non-metalli
Manufacture of basic
Manufacture of fabricated metal
Manufacture of computer, electro
Manufacture of electrical equipm
Manufacture of machinery and equ
Manufacture of motor vehicles, t
Manufacture of other transport e
Manufacture of furniture; other
Repair and installation of machi
Electricity, gas, steam and air
Water collection, treatment and
Sewerage, waste management, reme
Construction
0
.5
1
1.5
GHG emission intensity, kg/€
direct intensities, kg/€
dir + upstr indirect, kg/€
Using FIGARO data, mentioned by Silvain!

The tao of cumulative carbon accounting

E-liability is a prominent version of cumulative carbon accounting. Proposed and developed by **R. Kaplan (Harvard) and K. Ramanna (Oxford)** since 2021. In France, the same idea is propagated under the name of **3-D method** by **'carbones sur factures',** initiated by **Jérômes Cazes.**

Cumulative accounting works straight from the definition of carbon content:

$$c_k = d_k + \mathbf{c}'\mathbf{a}_k = d_k + \sum_i c_i a_{ki}$$

Like VAT, carbon content information is passed through the system, from input provider to producer and further down the supply chain, to the end-user.To allocate emissions to output, all standard methodology of cost accounting is used! Direct and indirect emissions are treated as **accounting liabilities**.

Direct information from providers or own measurement have highest priority. Data gaps are filled using estimates, eg from statistics.

Top down and bottom up

Producers do not need to know the carbon contents of the entire economy, **only those of their own providers** (or estimates thereof), just as for **cost accounting** we do **not need to know the entire price system, just what our providers charge.**

If all producers give a fair estimate of eq (1) using the information they have, i.e.

- Direct emissions,
- Bill of Material (BoM),
- GHG values of input providers if available, estimates if not

and if this information is disclosed and used by all participants alike, in equilibrium the resulting system of GHG values **will correspond to the solution given by eq (2**)

On convergence see the presentation of François and von Kalckreuth, Ulf, Pulling ourselves up by our bootstraps: the greenhouse gas value of products, enterprises and industries, Deutsche Bundesbank Discussion paper 23/2022.

Calculating carbon content

- **We may approximate missing input carbon content** using
  - sectoral data from SEEA and EEIO models
  - granular data from company level data on provider firm
  - granular carbon content of reference products

- Disclosed carbon contents and data for proxy valuations can be **disseminated centrally!** It is important that producers use their proprietary information on inputs and direct emissions!

- Tomorrow in Session 3b: The use of statistics data in carbon accounting, simulation study based on US data

The workshop: common points emerging (1)

The workshop was a testing ground for identifying joint views and shared issues to solve, among industry specialists, academics, standards-setters, central bankers, and statisticians.

Key message: carbon content information can be gathered and processed alongside financial information, using the same concepts and the same infrastructure:

- Balance sheets
- Financial and cost accounting

This is a **vision** and a **challenge**

Essential role of carbon content – direct plus upstream indirect emissions -- for cumulative carbon accounting

The workshop: common points emerging (2)

The workshop was a testing ground for identifying joint views and shared issues to solve, among industry specialists, academics, standards-setters, central bankers, and statisticians.

- Crucial role of **reliable and relevant carbon content data** at both macro and micro levels
- We need to move fast, therefore the need to **leverage on what exists**
- Need for a global approach -- **compatible standards**
- The importance of **process efficiency**, minimising burdens on entities
- The application of latest **digital technologies** for compilation, reporting and data flow
- The role of **incentivisation** techniques
- The benefits of **inter-disciplinary cooperation** (industry specialists, academics, standards-setters, central bankers, statisticians…)

Statistical data

- Macro statistics are the predominant form of public data available now
- But they are:
  - **Highly based on assumptions** >> can be improved with data from industry
  - **Not granular** >> need to work on more detailed industry/product breakdowns
  - **Patchy in coverage** across countries >> role of Data Gaps Initiative
  - Role of statistics to help filling gaps and support convergence in microdata
- Importance of efficient **statistical access to emerging microdata**, **sharing of classifications and definitions** where possible

Direct measurement

- Situation is **unsatisfactory.** Estimates and rules of thumb predominate. No clear view of total emissions

- Workshop saw many innovative approaches…
- Increasing role of **satellite imagery** –> in this conference an entire session
  – Certainly at macro level
  – Surprising advances at micro level
- Combining / contrasting direct measurement data – they can build on each other
- How can developing expertise at industry and scientific levels be pooled?

Making information available

- Challenge to present carbon content data alongside financials
  - **At macro level** for policy purposes
  - **At entity level**, alongside financial statements
  - **On products** in an informative and standardised way

- How to bring data together?
  - **Commercial initiatives**
  - **The ECCBSO / CMFB** initiative: collecting CSRD company level data for statistics
  - Possible proliferation of data bases

Conclusion

– For **direct emissions, direct measurement** should have priority (incl. satellite recognition and measurement based on chemical composition)

– For **upstream indirect** emissions, priority should be with **communication by input providers**

– **Official Statistics can help to estimate Scope 2 and upstream Scope 3** data where no direct information from the supply chain is available
  - Emission data and Input-Output data within multi-regional Input-Output tables
  - Disaggregated information for industries where emission intensities are heterogeneous will enhance the quality of firm level estimates
  - Distinction between various modes of energy production needed

– **Official Statistics can set a good example for data compilation:**
Strict accounting approach in macro statistics