Product level greenhouse gas contents – how to get there?

Pulling ourselves up by our bootstraps

Dr. Ulf von Kalckreuth, DG Statistics, Centre of Excellence, Deutsche Bundesbank

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GHG value – the vision

- This talk is on mitigation. For decision making with an eye to emissions, we need **product level carbon content information!**
- Deutsche Bundesbank Discussion Paper 23/2022
- **GHG value: direct and indirect GHG emissions on the product level**
- **Implicit definition: GHG value** depends on **direct emissions**, **inputs** and **their GHG value**!
- GHG use is indicated **on every stage of production and passed on**, like a second price tag!
- **Producers, investors, consumers and political authorities** can have the information needed for decision making. Competition among producers may induce rapid adjustment!
- Carbon taxes work on the supply side, from the beginning to the end of the supply chain. The GHG value **works on the demand side, from the end to the beginning of the value chain**!

Indirect emissions

With GHG values for all products, the system can work smoothly.
But for most goods, there aren‘t. **How do we get there?**

(1) GHG value equation – an IO approach

Consider the vector of inputs of product *k*, with $a_{k,i}$ being the quantity of good *i* embodied in the production process of one unit:

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

Let d_k be the amount of GHG directly emitted and g_i be the GHG value of input *i.*
Then the GHG value of good *k* is given as the **sum of direct and indirect emissions**:

GHG value vector — direct em. — indirect em. — value structure — quantity structure

$$g_k = d_k + \mathbf{g}'\mathbf{a}_k = d_k + \sum_i g_i a_{ki} \qquad (1)$$

If the g_i are known, we can calculate the GHG value of product k directly, based on our knowledge of direct emissions and technology.

The reduced form

If the g_i are unknown, the GHG value is still defined. The equation is **recursive**. Eq. (1) is an **IO model for production**. We can solve for the GHG values 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 Input coefficients for all produced goods. With **d** the vector of direct emissions for products 1,…, *K*, we may write:

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

Sectoral level: this can be calculated from existing data.

and solving for **c** yields

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

Micro level: we do not need to compute this solution. Let decentralised information processing do the work!

GHG values of all goods

Direct emissions for all goods

Leontief inverse, reflecting production interlinkages

(2) Accounting and sparse micro level communication

Robert Kaplan (Harvard) and **Karthik Ramanna (Oxford):** Harvard Business Review November/December 2021

K&R propose to treat emissions as a liablility -- **E-liability** -- that is moved forward with input supply along the supply chain and allocated over products. E-liabilities can be a measure of total (direct and indirect) GHG content – conceptually, emissions are collected over the value chain.

Introduce a sparse information flow from input providers to producers! The relevant information is revealed, but neither inputs nor technology!

Standard techniques and routines can be used to process E-liability information. Allocation of emissions to products largely unconstrained, left to producer.

To adress the **issue of missing input information**, **circular value chains** and to ensure **comparability**, the linear structure outlined above is extremely useful.

The key result

Producers do not need to know the GHG values of the entire economy, **only those of their own providers,** or estimates thereof!

Information processing very effectively on a decentral basis. Iterating equation (1) **will lead to the correct GHG values**!

Operational version of the definition equation

$$\tilde{g}_k = d_k + \tilde{\mathbf{g}}'\mathbf{a}_k$$

Input coefficients, known by producers

Producers‘ GHGV estimate

Direct emissions, known by producers

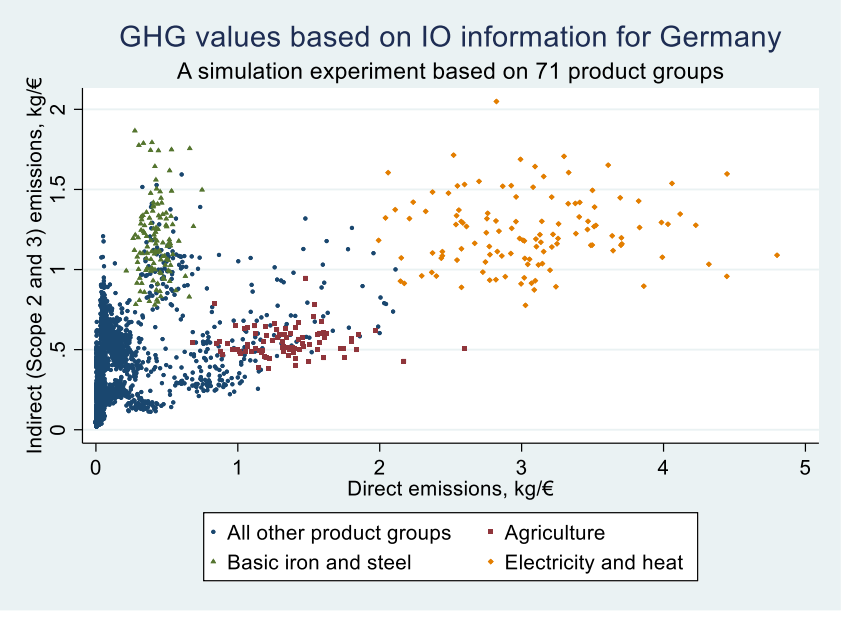
GHGVs stated by input providers or estimates as inital values

This is shown both **analytically** and **by simulation**, based on production interactions in Germany.

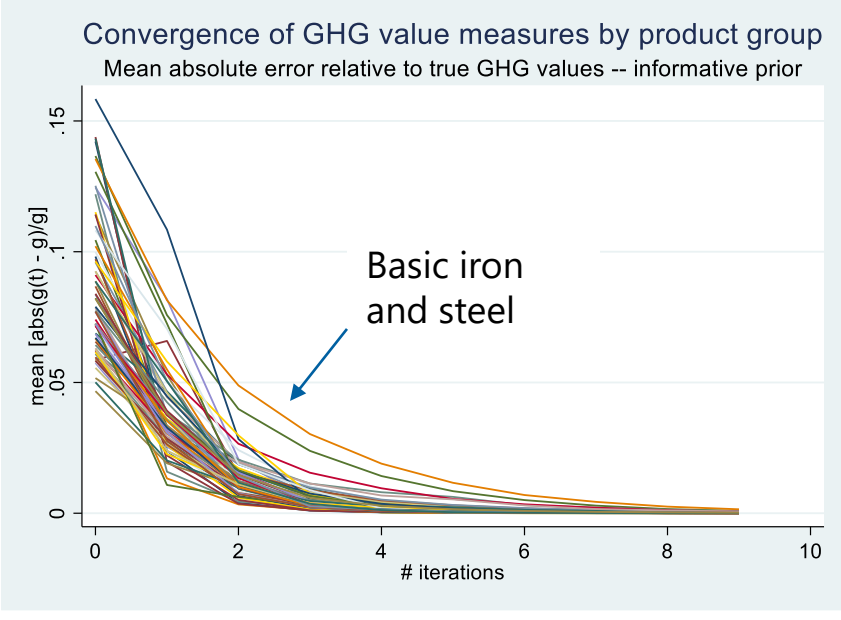
Jumpstart the system and boot it bottom up! Hayek and the **„man on the spot“!**

Simulation – market learning of the GHG value system

Simulating GHGVs for 7699 products



Evolution of mean absolute error



The first step (use of private information on input structure) is the most important

Signalling and a role for institutions

Signalling

There is a path that leads to **voluntary disclosure by (almost) all firms:**

Disclosure is a signalling game

- Producers with low GHG value will have an **incentive to disclose, as they can charge higher prices.**
- **Signal value** for the **decision not to disclose**
- **Reinforced** by **disseminating disclosed GHG values on a central data platform**
- **Reinforced further** by **calculating sector averages conditional on not disclosing**

Auditing and an information platform

Auditing to make sure that the GHG values are a fair estimate

Centralised platforms to make available the existing information

- on **industry averages**
- on GHG values on a **product** and on the **company level**, if available

Compute estimated carbon content for firms of a given industry that do not disclose their GHG values, from the known industry averages and the known GHG values of the firms that do disclose.

Strong incentive for disclosure!

Policy options for central banks and international organisations

The GHG value is a **decentral information system**, but it needs **institutional support**, **eg from central banks and international organisations**

1. Co-operate with Statistical Institutes in setting up a **rather disaggregated IO-models.** This **will give us useful group level GHGVs immediately** and serve as a basis for product level GHGVs. Already suggested for the **Data Gaps Initiative within the G20.**
2. Set up and maintain a **dissemination platform for GHG value data** on the level of sectors, enterprises and products (eg with CPA classification system as a basis)
3. Support development of **disclosure standards**, as a basis for comparability and auditing. For direct emissions, those rules can build on the relevant GHG Protocol standards.
4. Interact with supervisory authorities and the IFRS on **disclosure and auditing requirements**, eg regarding the CSRD. Possible disclosure requirements should target large companies, as well as producers of primary goods and importers.

In addition, **support for ongoing field studies** may be very useful!