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Structural Production Layer Decomposition

A new method to measure differences between MRIO databases for footprint assessments

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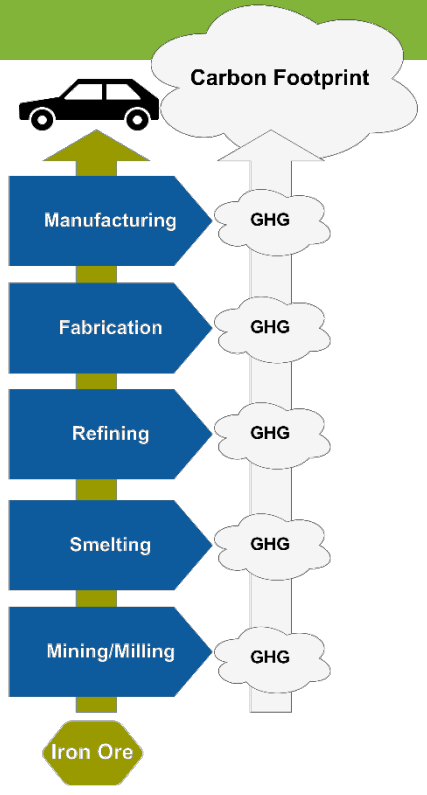
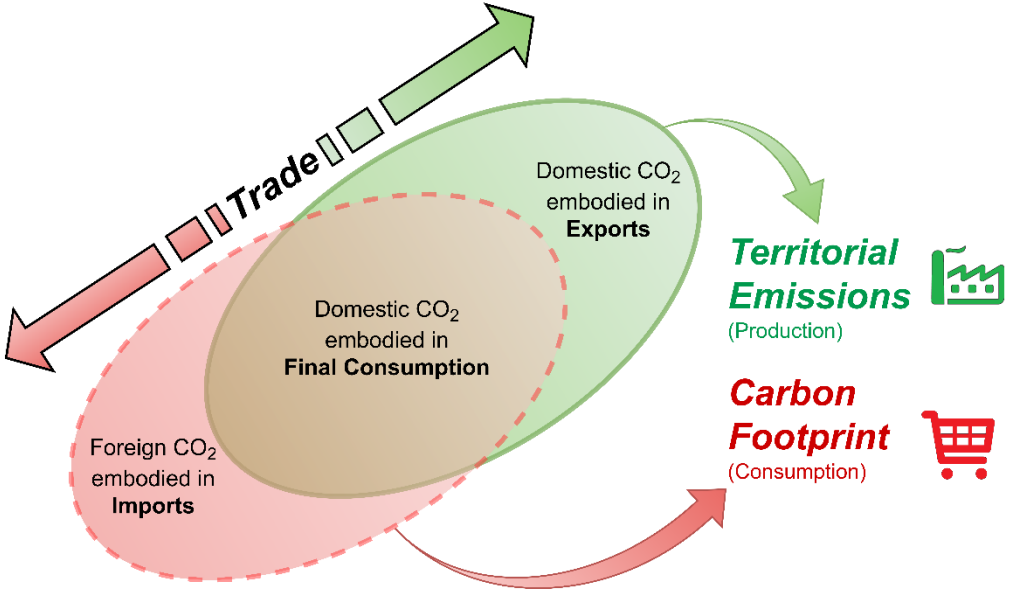
The Carbon Footprint

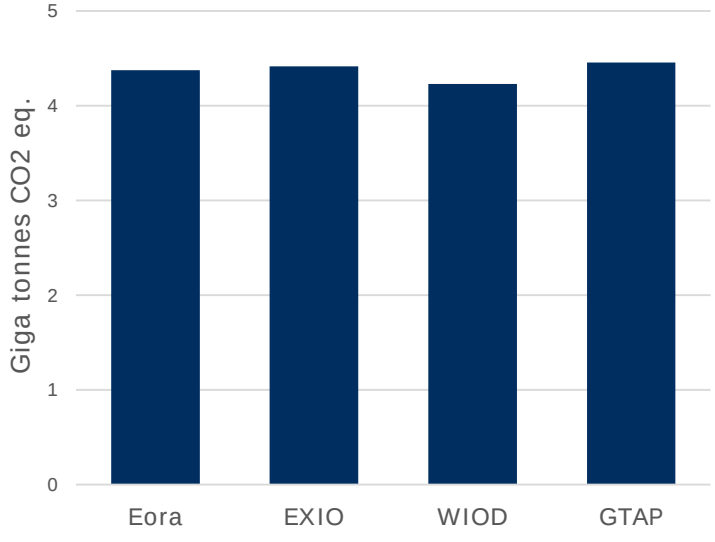


The industry-perspective

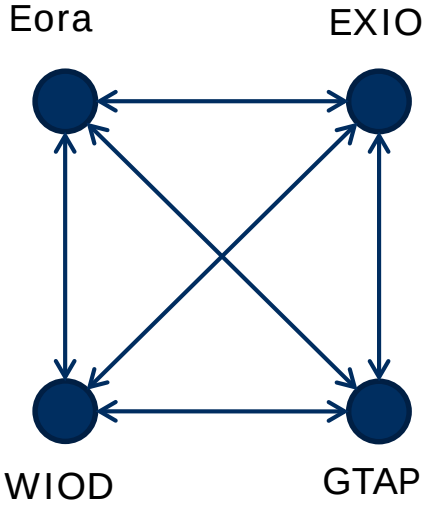


The country-perspective

Comparing the four key MRIO's

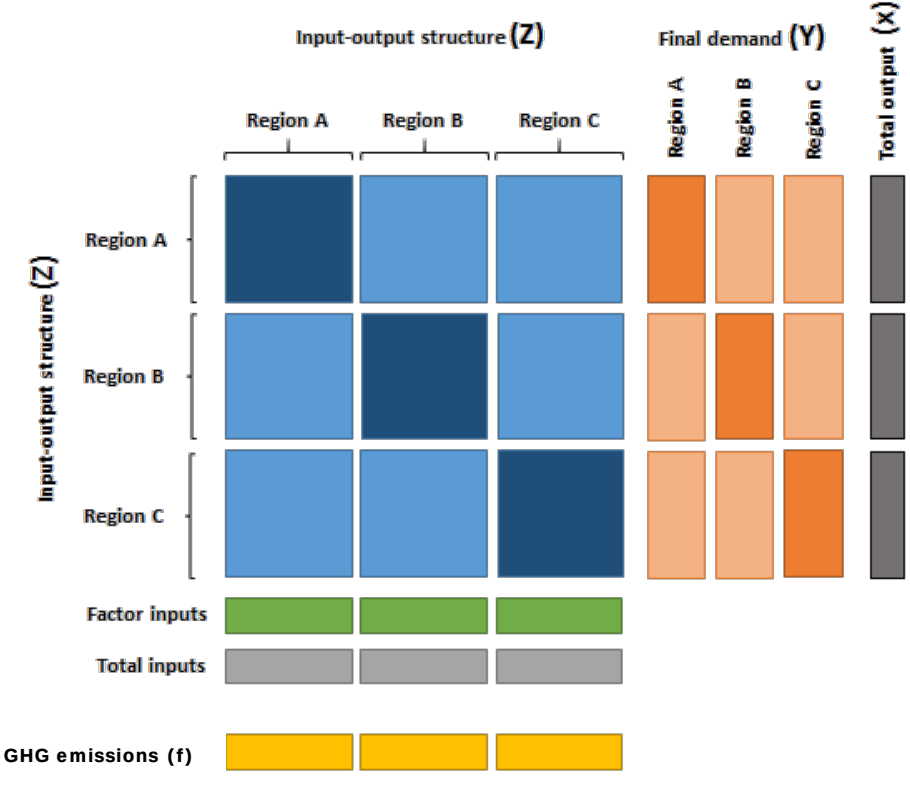


Carbon Footprint of EU-28 in 2011
(identical environmental extension and a common classification)



4 MRIOs = 6 pairwise comparisons

Multi-Regional Input-Output modelling



Technology Matrix:

$$\mathbf{A} = \mathbf{Z}\,\hat{\mathbf{x}}^{-1}$$

Total Leontief Multiplier:

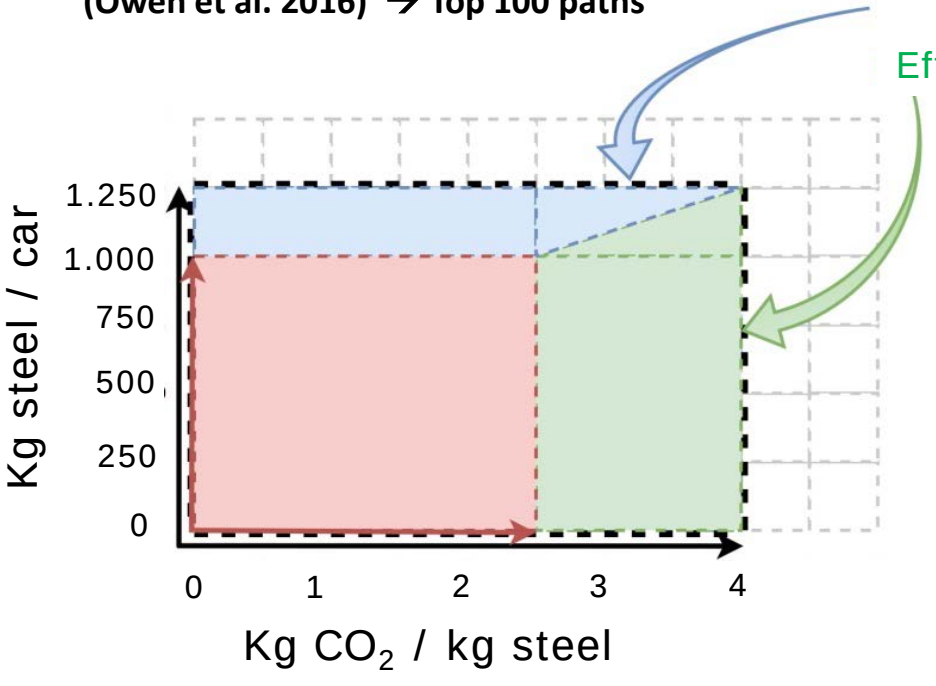
$$\mathbf{L} = \mathbf{I} + \mathbf{A} + \mathbf{A}^2 + \mathbf{A}^3 + \cdots$$

$$\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$$

$$\boldsymbol{Carbon\ Footprint} = \hat{\mathbf{f}}\,\hat{\mathbf{x}}^{-1}\,\mathbf{L}\,\hat{\mathbf{y}}$$

Structural Decomposition
of supply chain (car ← steel ← CO_2)

- Based on model from **(Sun, 1998)**
- Structural Path Decomposition Analysis **(Owen et al. 2016) → Top 100 paths**



Effect from **changes in steel-use**

Effect from **changes in steel-production**

$$1000\ \frac{kg\ steel}{car} * 2.5\ \frac{kg\ CO_2}{kg\ steel} = \mathbf{2500}\ \frac{kg\ CO_2}{car}$$

$$1250\ \frac{kg\ steel}{car} * 4\ \frac{kg\ CO_2}{kg\ steel} = \mathbf{5000}\ \frac{kg\ CO_2}{car}$$

SPLD result for **EU-28 carbon footprint**
Eora vs. EXIOBASE, industry-perspective

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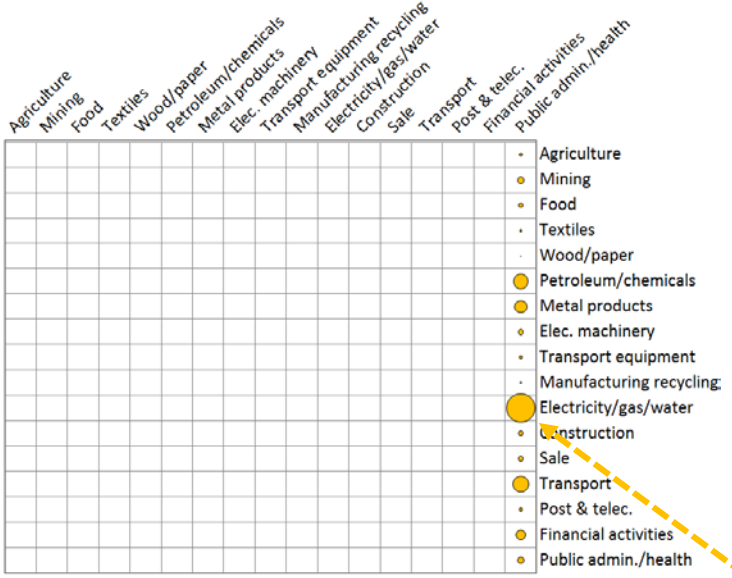
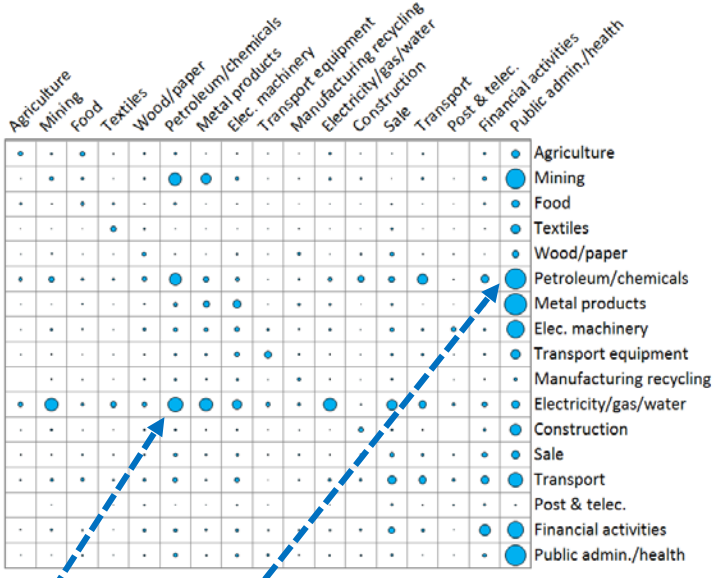
SDA (total multiplier perspective)



SPLD (technology perspective)



Example

$$Structural\ Path = \frac{f_{11}}{x_{11}} * \Delta a_{11,6} * \Delta a_{6,17} * y_{17}$$

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SPLD result for **EU-28 carbon footprint**
Eora vs. EXIOBASE, country-perspective

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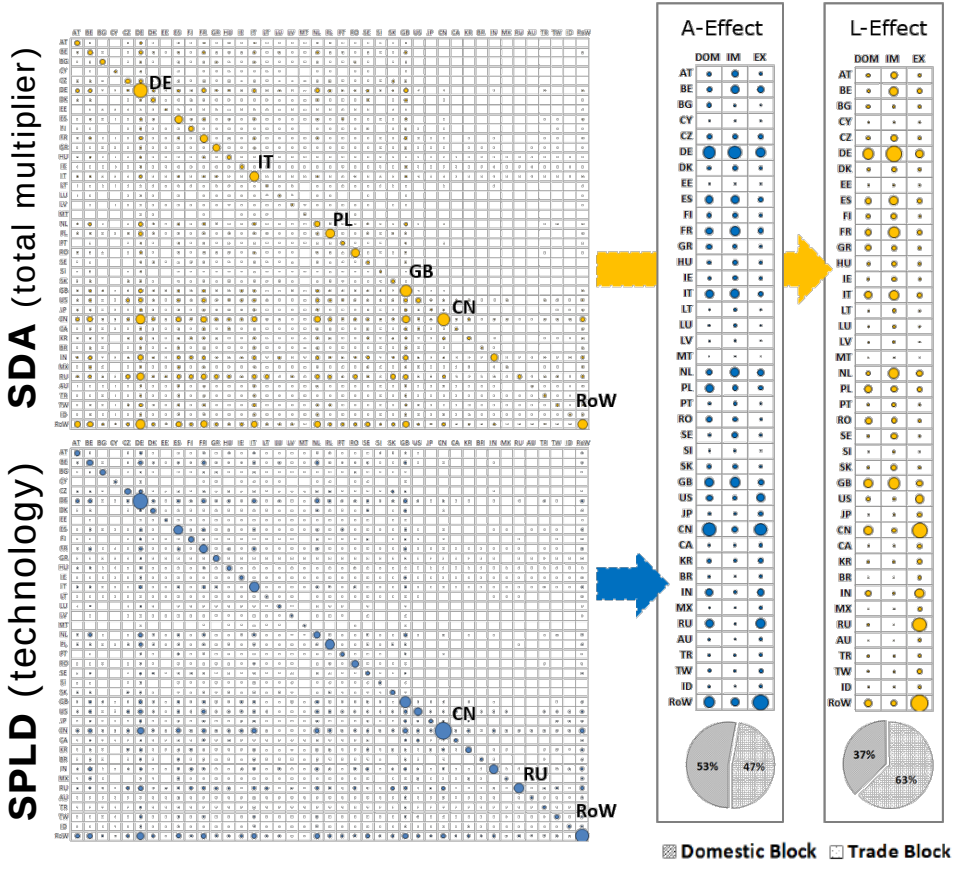

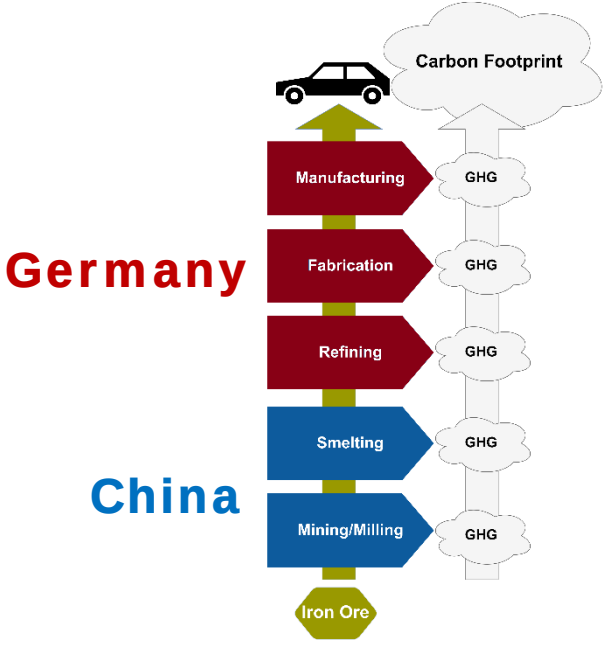

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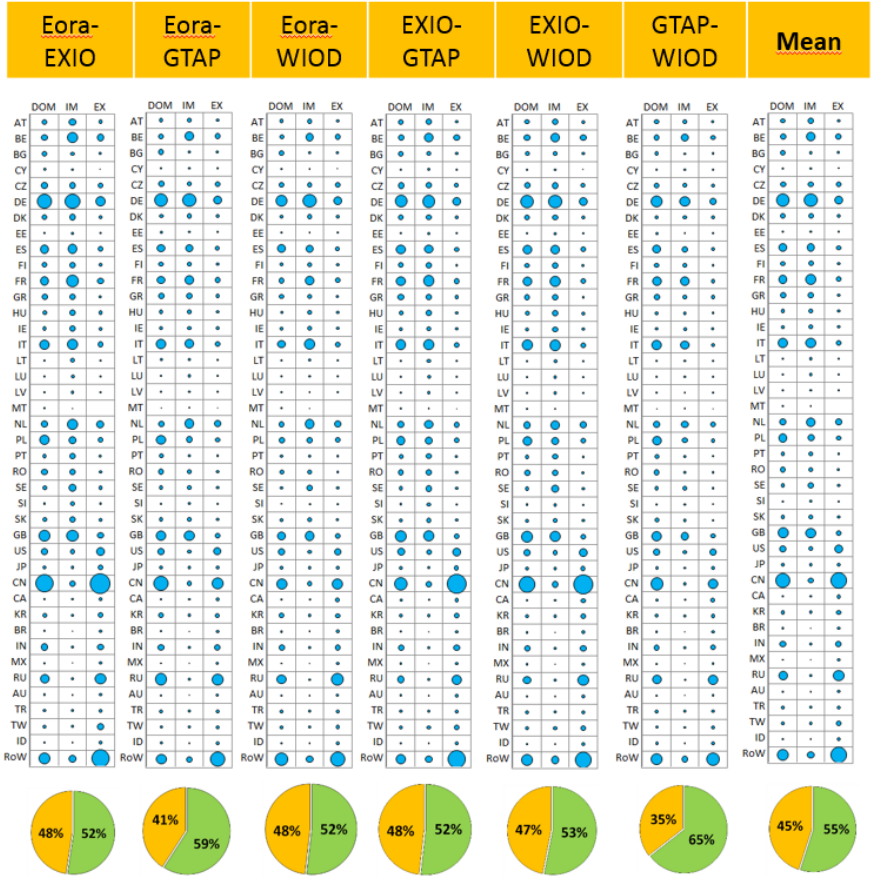
SPLD result for EU-28 carbon footprint: All six MRIO-pairs



Conclusion

- **Domestic flows have larger contribution** to difference in MRIO databases than trade flows
- Key technique to determine the cause of changes within supply chains in a **year-on-year decomposition**
- **Limitations:** Computation time and power
- **Directions for further research:** systematic comparison of assumptions and data manipulation procedures

Thank you!

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