

IEooc_Methods5_Exercise4a: Calculating income specific footprints for Germany

Goal: Learn how to use *pymrio* with a new final demand matrix to calculate footprints for that final demand. Learn how to analyze and plot the results.

Prerequisites

- Basic knowledge of Input-Output Analysis (completed part **Methodology 5: Input-output analysis** of the IEooc)
- Basic knowledge on Python (see here for help https://simschul.github.io/python_basics/python_cheatsheet.html)
- Basic knowledge (and an installation) of the Pymrio python package (read <https://pymrio.readthedocs.io/en/latest/intro.html#>)
- EXIOBASE for the year 2013 in the product by product variant (pxp) (you can find it here: <https://zenodo.org/records/5589597> , download the file “IOT_2013_pxp.zip” and save it to your computer)

Different levels

- Expert level: Only read the instructions provided in this file and solve the exercise by yourself
- Intermediate level: Open the file “IEooc_Methods5_Exercise4a_calculate_income_specific_footprints_TODO.ipynb” and complete all code lines marked by #TODO
- Basic level: Open the file “IEooc_Methods5_Exercise4a_calculate_income_specific_footprints_SOLUTION.ipynb” and go through it step-by-step

Background

In this exercise you will calculate footprints of different income groups in Germany for the year 2013. We will use household expenditure data for 11 income groups ranging from households with a monthly income of less than 900 Euro to more than 18000 Euros. The income-specific expenditure data originates from the German “Einkommens- und Verbrauchsstichprobe” (EVS) and has already been

Methods Part 5 (Input-output analysis)

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mapped to EXIOBASE sectors and regions by a colleague of ours who used this data in a publication (Hardadi et al., 2020).

The data is provided as two separate .xlsx files:

“IEooc_Methods5_Exercise4ab_Final_demand_by_income_avg.xlsx” containing average values per income group, and “IEooc_Methods5_Exercise4ab_Final_demand_by_income_std.xlsx” containing standard deviations required to conduct an uncertainty analysis.

In this first part, we will only make use of the first file.

Exercises

1. Import the file `IEooc_Methods5_Exercise4ab_Final_demand_by_income_avg.xlsx` in your Jupyter notebook.
2. Import EXIOBASE for the year 2013 in the product by product variant (pxp) using pymrio.
3. Calculate the **total footprints by income group** for all impact categories (use the **S** and **L** matrix from EXIOBASE and the **Y** matrix from the file loaded in step 1.
 - a. Extract the footprints related to the three major Greenhouse gases CO₂, CH₄ and N₂O. Note there are different variants, choose the one where CH₄ and N₂O emissions are measured in CO₂-equivalents (CO₂EQ).
 - b. Visualize the income-specific GHG footprints by greenhouse gas using your favorite plot library and an adequate plot type.
4. Break down the income-specific CO₂-Footprints* by final product. What are the top 3 products (summed over all regions) that contribute most for each income group? (*use impact category `Carbon dioxide (CO₂) CO₂EQ IPCC categories 1 to 4 and 6 to 7 (excl land use, land use change and forestry)`)

References

Hardadi, Gilang, Alexander Buchholz, and Stefan Pauliuk. “Implications of the Distribution of German Household Environmental Footprints across Income Groups for Integrating Environmental and Social Policy Design.” *Journal of Industrial Ecology* 25, no. 1 (2020). <https://doi.org/10.1111/jiec.13045>.

Statistisches Bundesamt. “Einkommens- und Verbrauchsstichprobe (EVS).” Accessed May 17, 2023. <https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Einkommen-Konsum-Lebensbedingungen/Einkommen-Einnahmen-Ausgaben/Methoden/einkommens-verbrauchsstichprobe.html>.

Acknowledgment:

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