The Carbon Footprint of Global Trade Imbalances

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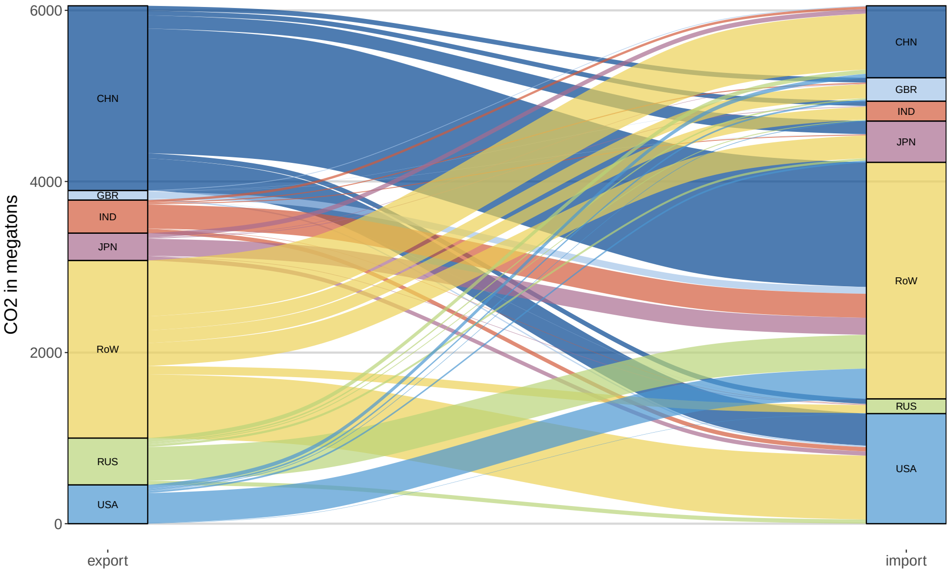
Motivation

Figure 1: Share of Global CO2 Emissions Embodied in Trade, 2000-2014

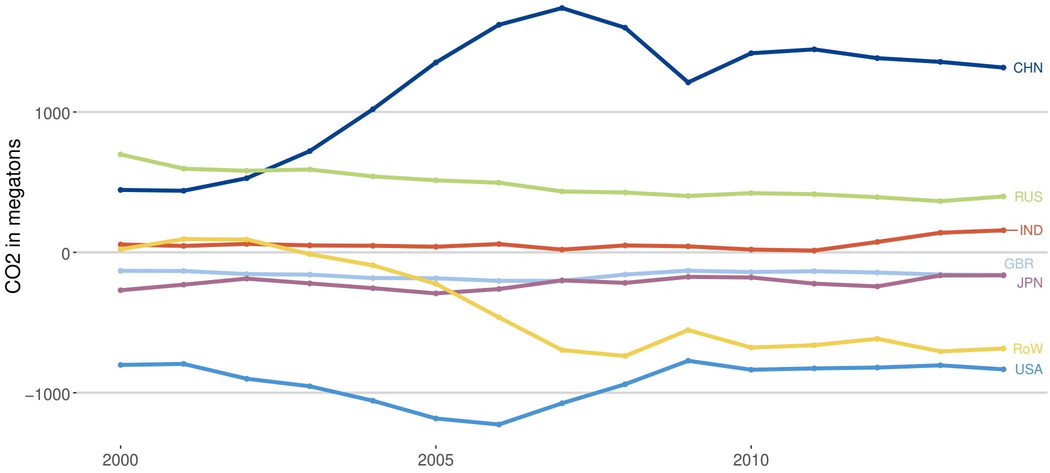
figures/embodied_emissions_in_trade_share-eps-converted-to.pdf

Figure 2: Bilateral Flows of Embodied CO2 Emissions in International Trade, 2014



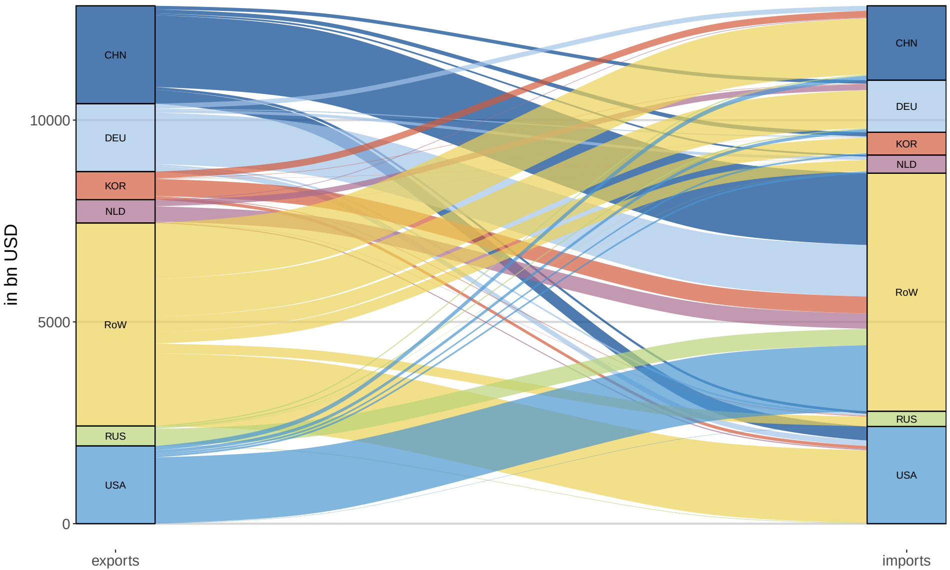
Source: WIOD, own calculation

Figure 3: Embodied CO2 Emissions Imbalance, 2000-2014



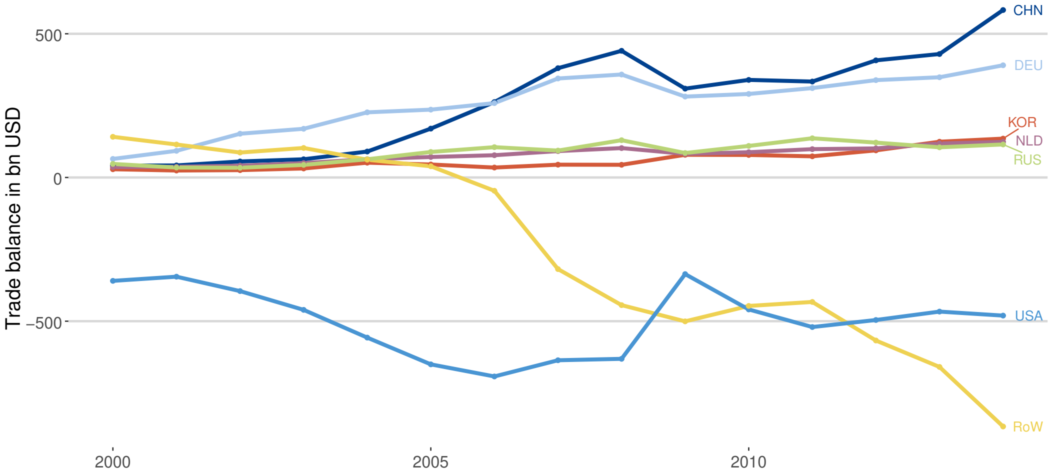
Source: WIOD, own calculation

Figure 4: Bilateral Trade Flows, 2014



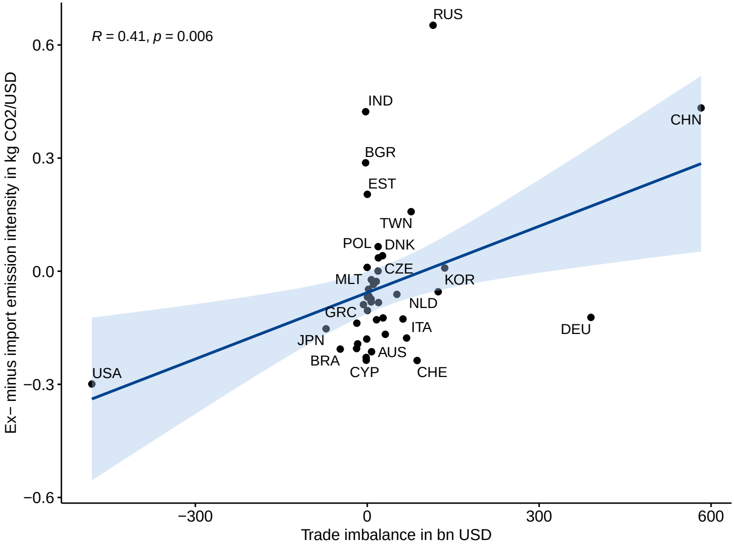
Source: WIOD, own calculation

Figure 5: Trade Imbalance, 2000-2014



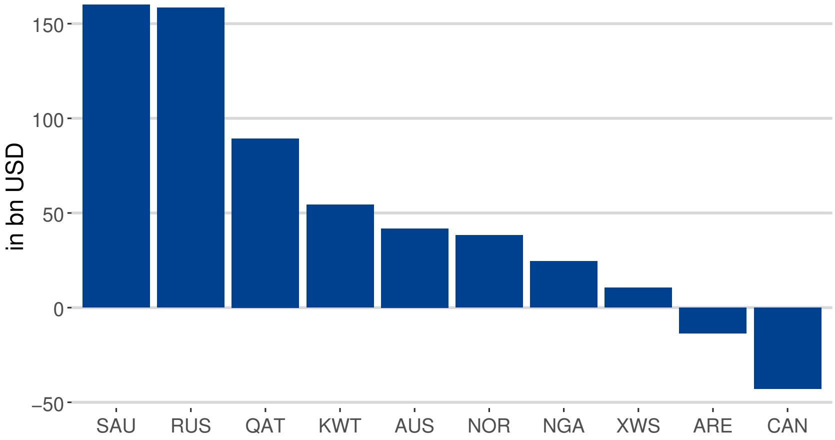
Source: WIOD, own calculation

Figure 6: Correlation of Trade Imbalances and Carbon Intensities of Exports vs. Imports, 2014



Source: WIOD, own calculation

Figure 7: Trade Imbalance of the 10 Largest Fossil Exporters, 2014



Source: GTAP, own calculation

Contribution

Related literature

- ***Sources* of trade imbalances:** ?, ?, Reyes-Heroles (2016), ?, Felbermayr and Yotov (2021).
- ***Consequences* of removing trade imbalances:** Dekle, Eaton, and Kortum (2007, 2008).
- **Trade imbalances and the environment:** Copeland, Shapiro, and Taylor (2021), Li et al. (2020).
- **Emissions in structural gravity models:** Egger and Nigai (2015), Shapiro (2016), Larch and Wanner (2017, 2019), Shapiro and Walker (2018), Caron and Fally (2020), ?.

Model & data

Model setup

Quantitative trade model à la Eaton and Kortum (2002)

- Trade between N countries (i, n) in multiple sectors with input-output linkages as in Caliendo and Parro (2015)
- J other sectors (j, k)
- F fossil fuel sectors (f, g)
  - $\rightarrow$ **Usage** as intermediates in production or in final consumption **causes emissions**

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Preferences: Two-tier Cobb-Douglas utility function

Production: Goods markets are **perfectly competitive**

International trade

Consumers and firms source goods from the cheapest supplier
International trade faces **iceberg trade costs** t_{ni}^{j} and t_{ni}^{f}, which gives rise to

- a set of sectoral **price indices**
- and sectoral **import shares**

$\rightarrow$ Sectoral version of the **gravity expression** of Eaton and Kortum (2002)

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Trade is multilaterally balanced up to the exogenously given **trade deficit**

$$\sum_{i\in\mathcal{N}}\left(\sum_{f\in\mathcal{F}} X^f_n \pi^f_{ni} + \sum_{j\in\mathcal{J}} X^j_n \pi^j_{ni}\right) - D_n = \sum_{i\in\mathcal{N}}\left(\sum_{f\in\mathcal{F}} X^f_i \pi^f_{in} + \sum_{j\in\mathcal{J}} X^j_i \pi^j_{in}\right)$$

Carbon emissions

National emissions are given by

$$E_n = \sum_{f \in F} \iota^f \left(\int_0^1 \left(C_n(\omega^f) + \sum_{g \in \mathcal{F}} m_n^f(\omega^f) + \sum_{j \in \mathcal{J}} m_n^f(\omega^j) \right) d\omega^j \right) = \sum_{f \in \mathcal{F}} \frac{\iota^f X_n^f}{P_n^f}$$

- Linking emissions to the fossil fuel ***usage***

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- Linking emissions to the fossil fuel ***usage***
- **?** links emissions to the ***extraction*** of fossil fuels

Data

Input-output tables

- GTAP 10 (**?**)
  - 141 countries (98% of world GDP)
  - 65 sectors: 5 fossil sectors (coal, oil, gas, petroleum and coal products, gas manufacture and distribution)
- Input coefficients (α, β, γ), bilateral trade shares (π), value added (wL), and initial trade imbalances (D)
- Prices (P^f) and carbon intensities of goods from fossil sectors (ι)

Trade elasticites

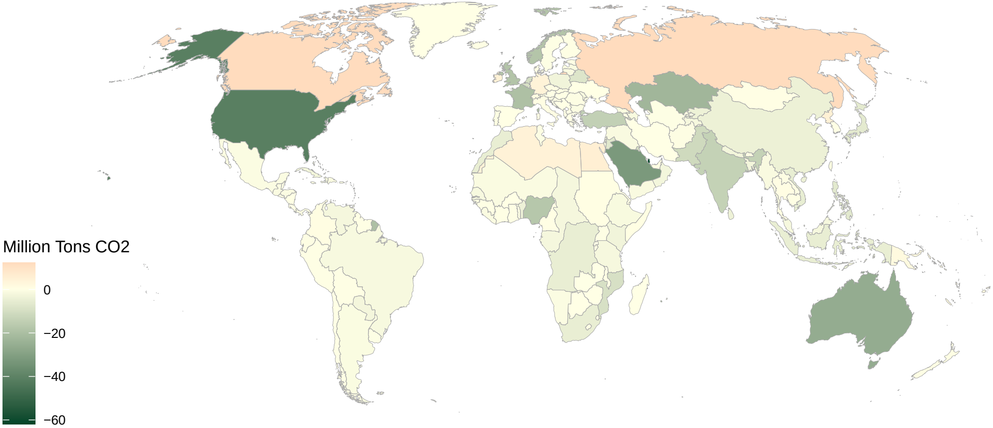
- Sectoral dispersion parameters (θ) from Fontagné et al. (2018)
- Service sectors: Egger et al. (2012)

Removing trade imbalances

Scenarios

1. Balancing individual country's trade **separately**
2. Balancing all countries' trade **simultaneously**

Figure 8: Change in Global Carbon Emissions from the Removal of the Corresponding Country's Trade Imbalance, Each Country Balanced Separately



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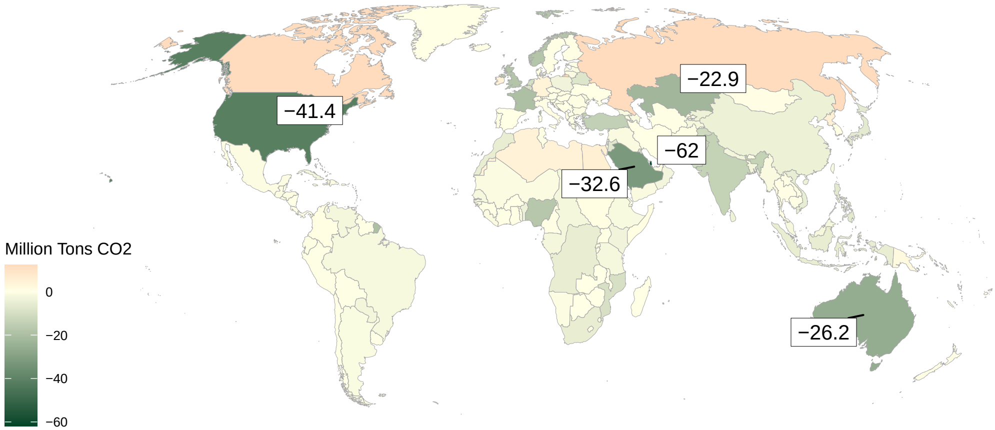


Figure 9: Change in Global Carbon Emissions per Absolute Value of Removing Trade Imbalance per Country, Each Country Balanced Separately

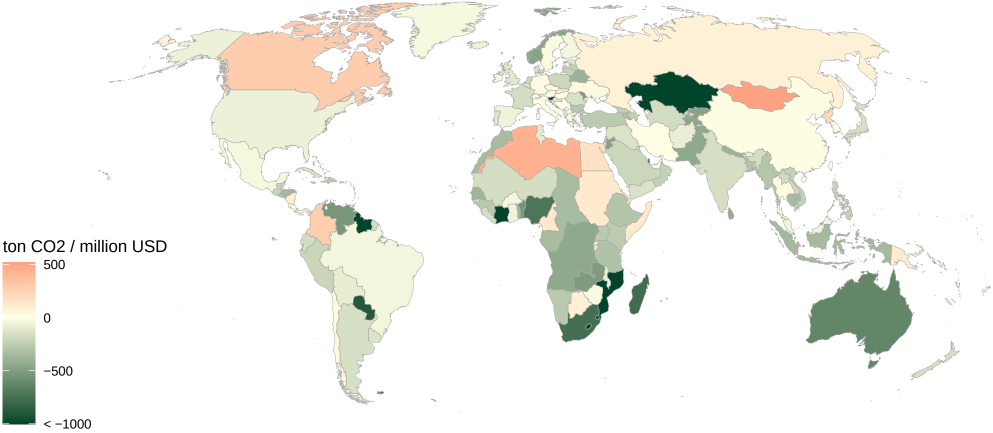
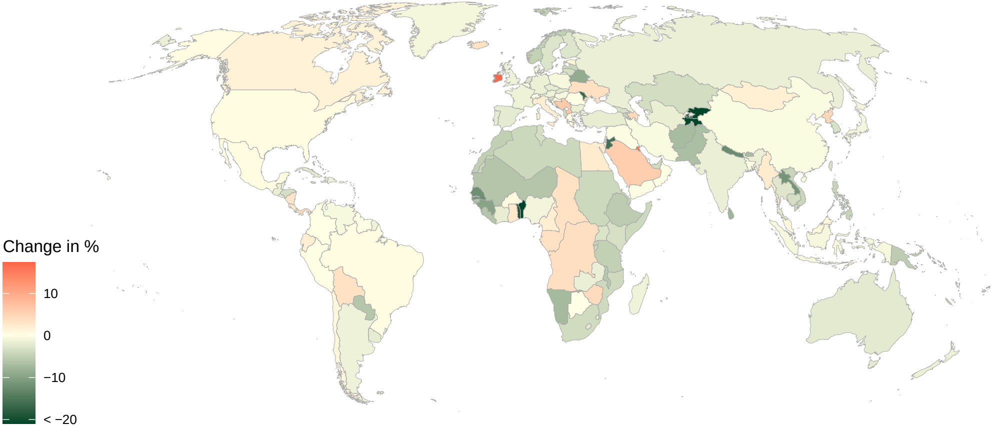


Figure 10: Percentage Changes in Countries' Carbon Emissions, All Countries Balanced Simultaneously



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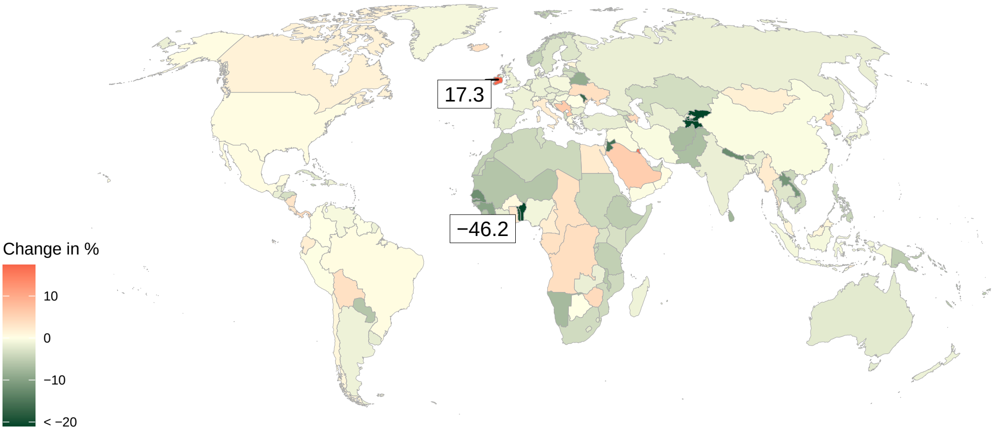

Conclusion

Contribution

- Implementing carbon emissions into a quantitative trade model
- Examine environmental consequences of trade imbalances

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Key findings

- Current pattern of global trade imbalances **raises environmental concern**
- Highest individual effects: Eliminating the US trade deficit or the trade surplus of major fossil fuel exporters, such as Qatar, Saudi-Arabia, or Australia.
- Re-balancing global trade would bring down global emissions by 0.62 %, **reducing the overall carbon footprint of international trade by more than 10 %**

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