

CO2 Emissions and Energy Technologies in Western Europe

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- **Objective:**
 - Understand the relation between **CO2 emissions and economic activity** → Short-run within country **elasticities** of CO2-GDP
 - Understanding the role of the **energy mix** and **energy intensity**
 - Exploring **business cycle dynamics** as driver of CO2 emission
→ counter-cyclical considerations
- **Theoretical and empirical approach**
 - Neoclassical growth model augmented with an **aggregate of energy use** → energy requirement fixed, various mechanisms to substitute energy with more energy-efficient capital.
 - Empirical model: **dynamic panel** data on a sample of **sixteen western European countries** for the period **1980-2019**.

- **Results and conclusions:**
 - **Positive CO2-GDP elasticities**, with substantial **heterogeneity** among countries
 - Changes/**Reductions in CO2 emissions per capita** and CO2-GDP elasticities **explained by both changes in energy intensity and the energy mix** (carbon content of energy)
 - The CO2-GDP elasticity is **higher in booms than in recessions** → Need to incorporate **short-run cyclical concerns** into climate policy: procyclical fuel taxes and regulations towards energy efficiency.
 - **Evidence of convergence** in CO2 emissions → Countries with higher (lower) initial levels have reduced emissions more (less) during the period.

General comments

- Very interesting and addresses a very relevant topic → Decoupling key to achieve environmental goals without compromising growth and current living standards.
- Very conscientious in the exploratory analysis of the data, performing the analysis country by country to attain more meaningful conclusions.

Carbon intensity / Energy mix

- Considering nuclear energy → ✓
- From a policy perspective, more than share of particular technologies (conditioned by substitution effects) → measuring broader concept of carbon intensity or decarbonization of energy, independently of the technology
 - Direct measure of carbon content/intensity of energy consumption (e.g. IEA data includes carbon emissions from last update)
 - Share of energy consumption from non-emitting energy sources

Subscription

Energy Efficiency Indicators

Annual data from 2000 covering end-use energy consumption, now featuring end-use carbon emissions for the IEA member countries and beyond

Last updated June 2022

Energy intensity

⇒ Changes in energy intensity can come from **different sources**

Decomposition could help to obtain some meaningful conclusions

- 1 **Energy efficiency** (i.e more efficient equipment and processes)
- 2 **Composition effects**

Structural composition of the economy (i.e increased or decreased specialization in polluting sectors).

- IEA data or proxying with share of VA of most polluting sectors from Eurostat or OECD

Energy intensity

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→ **decomposition** can help to obtain some meaningful conclusions

① **Energy efficiency** (i.e more efficient equipment and processes)

② **Composition effects**

Structural composition of the economy (i.e increased or decreased specialization in polluting sectors).

⇒ **Trade**

Specific comments: Energy intensity

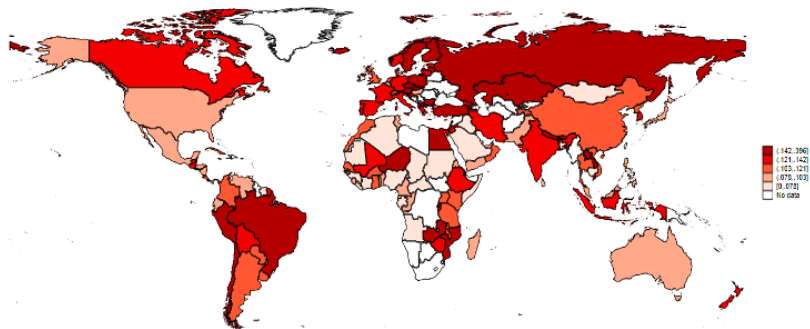
⇒ Trade

- Following liberalization, more polluting trade and industries tend to concentrate in countries with lax environmental regulation → known as "**pollution havens**"
- Dirty industries tend to be capital intensive → redirected countries with **higher levels of capital-to-labor endowments**

The combination of more stringent environmental norms and trade liberalization in the last decades → Substantial **heterogeneity across European countries** in the environmental content of their trade and **variations over time**

Specific comments: Trade

Figure 2. Dirty trade (% of total trade). Average 2002 - 2018

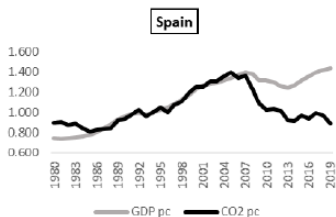


⇒ Trade

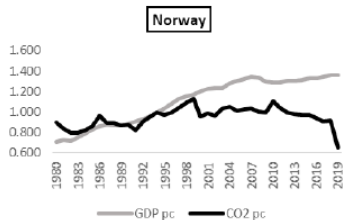
- Changes in energy intensity stemming from trade may not be desirable from a policy perspective → decoupling stems from carbon leakage
 - Share of dirty exports/trade (CEPII) or carbon content of trade (e.g. recent OECD database on carbon emissions embodied in international trade)

Specific comments: Others

- 1 More than average elasticities over the period \implies changes over time
 - Structural breaks?



(m) Per capita GDP and CO2 Spain

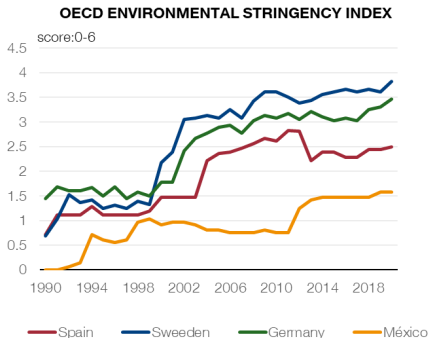


(k) Per capita GDP and CO2 Norway

Specific comments: Others

① Stringency of environmental regulation

- The authors reflect on this issue → but conclude homogeneity of institutions should help to reduce any problem derived from omitting it.
- However, differences among European countries **not so small, specially considering long time periods**



- This is a good paper, very carefully executed and I rather engaging.

CONGRATULATIONS ON YOUR WORK!

Thank you for your attention