EMISSIONS AND GROWTH:
Trends and Cycles in an Integrated World

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Based on ongoing work with
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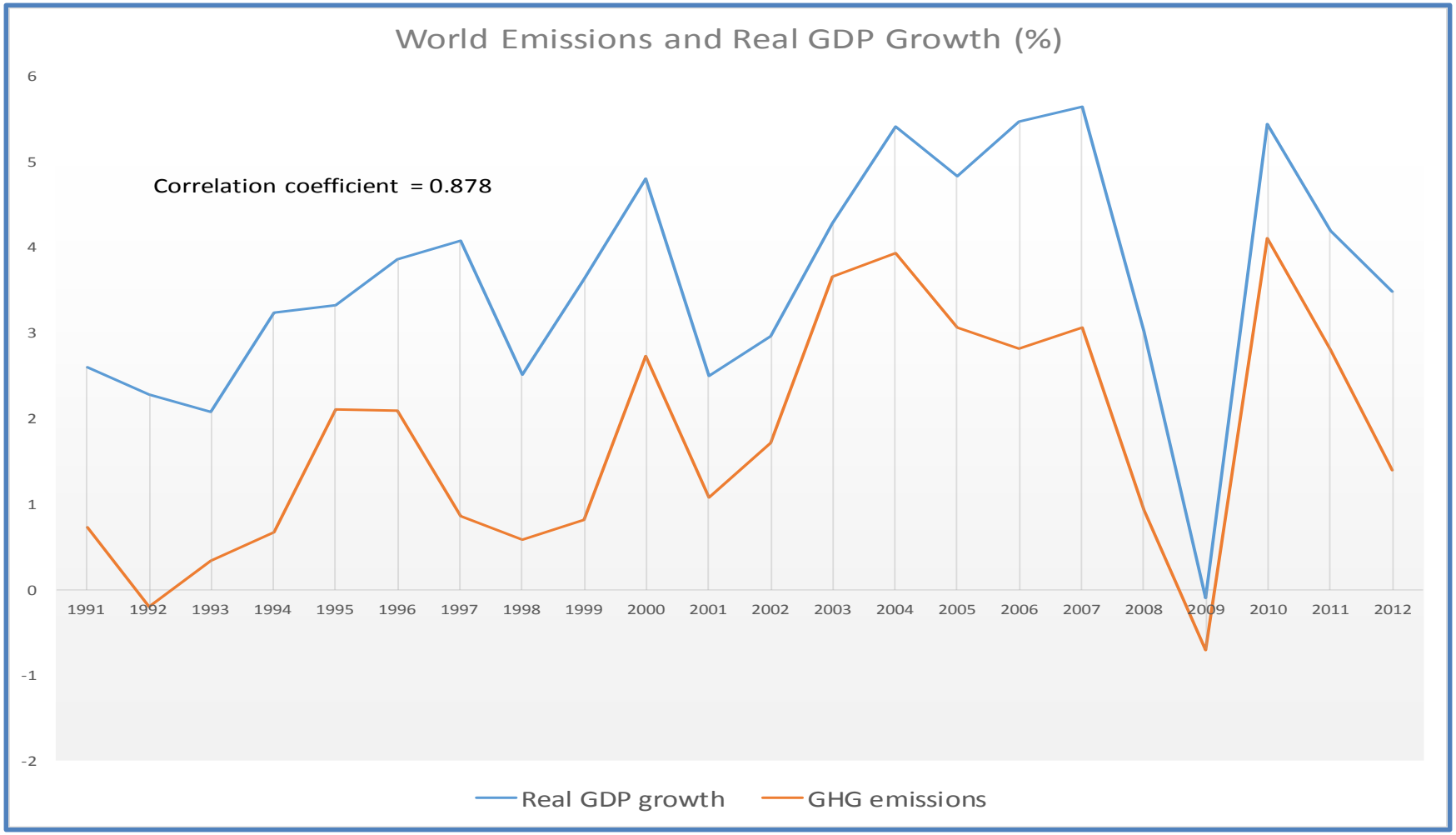
Presentation at
Mercator Research Institute on Global Commons and Climate Change
January 12, 2017

VIEWS EXPRESSED ARE THOSE OF THE PRESENTERS
AND SHOULD NOT BE ASCRIBED TO THE IMF OR THE NAS.

We are grateful for discussions with Manoj Atolia, Baran Doda and Clara Galeazzi
and comments from colleagues in the Development Macroeconomics division (RESDM)

Where's the decoupling?

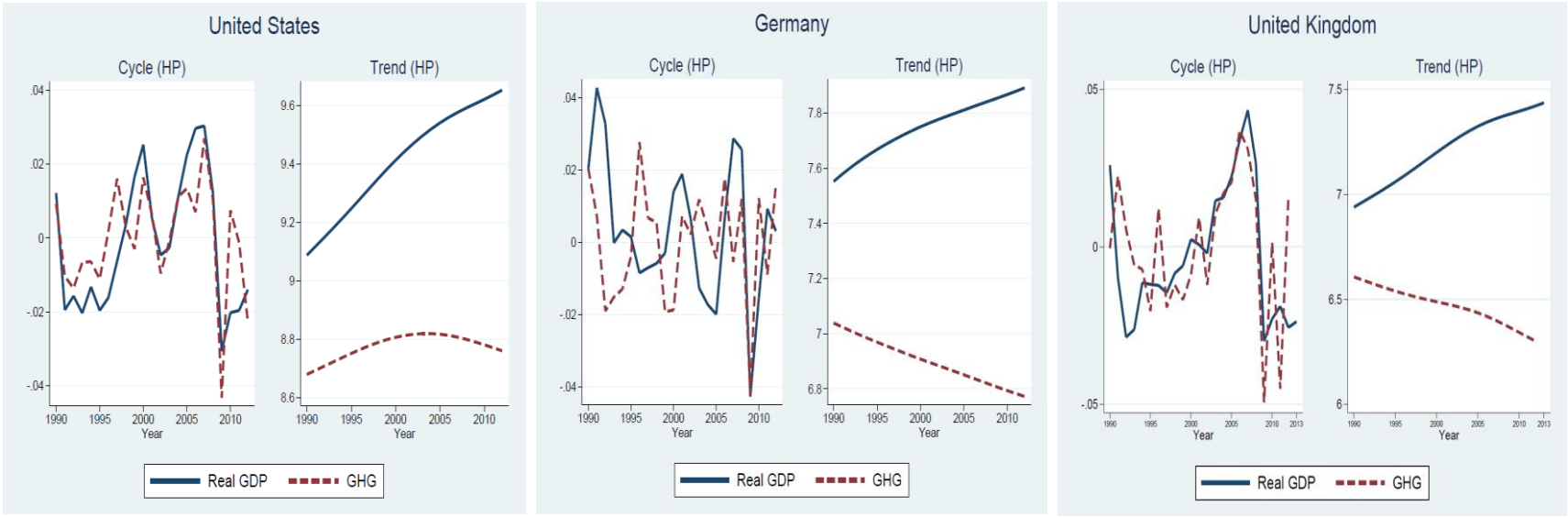


Where's the decoupling? Summary of our results

- *Need to distinguish trends from cycles (Doda 2014)*
  - *An Environmental Okun's Law (EOL)—the cyclical relationship--obscures the Environmental Kuznets Curve (EKC)—the trend relationship*
  - *EKC estimates do show de-coupling of emissions and GDP for many countries*

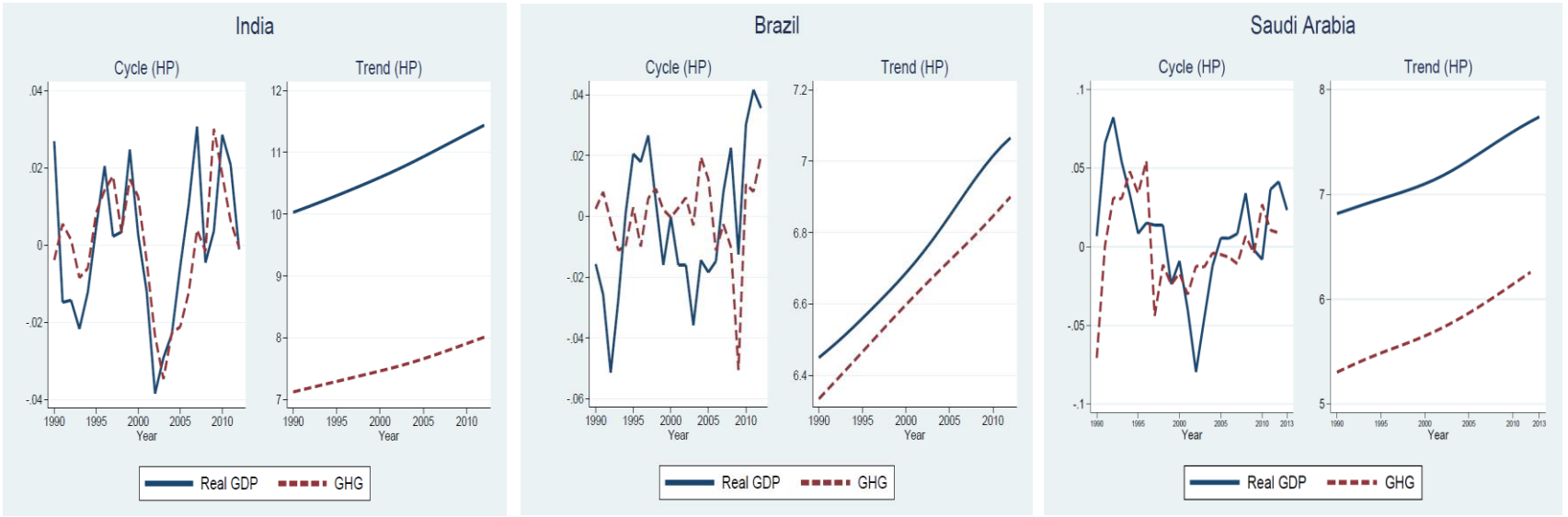
  But:
- *Accounting for trade complicates the story*
  - *Consumption-based EKC estimates show much less de-coupling than production-based EKC estimates*

Cycles can obscure trend movements: some advanced countries



- Cyclical and trend components extracted with the Hodrick-Prescott (HP) filter, with smoothing parameter = 100.
- Results are robust to alternative filtering methods, in particular with Hamilton's detrending method (2016).

Cycles can obscure trend movements: some emerging economies



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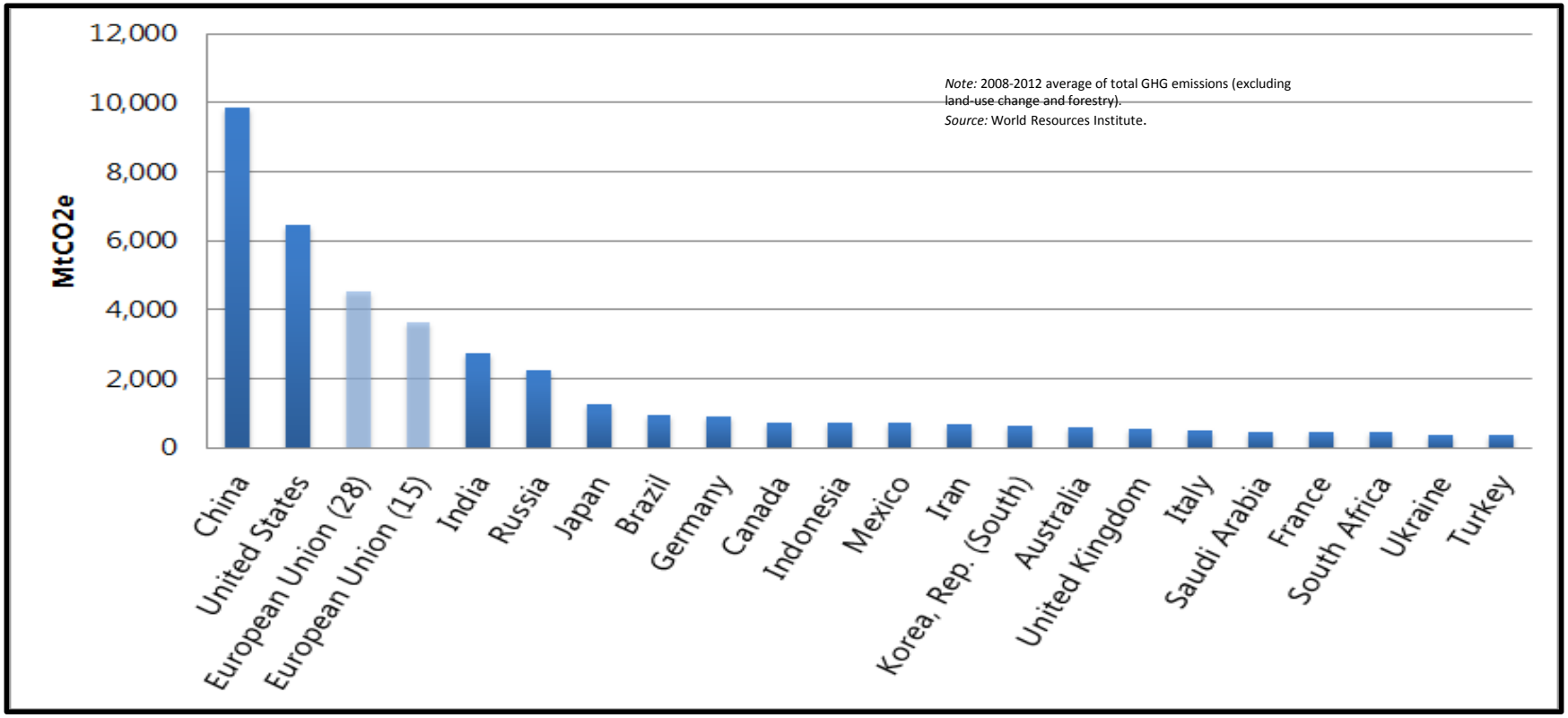
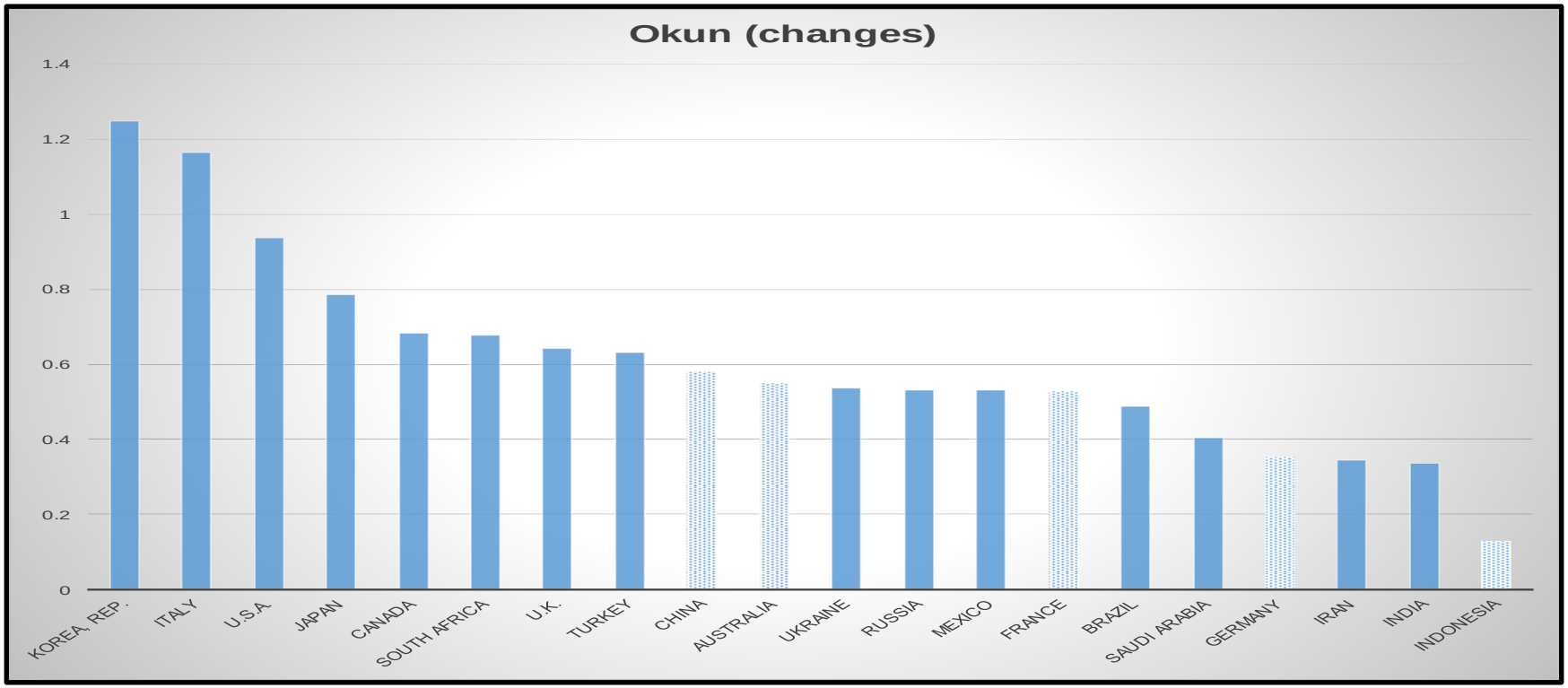
TRENDS AND CYCLES

Top 20 world emitters



- The 20 largest GHG emitters contribute 74% of world emissions and account for 63% of the world's population and 77% of world's GDP.

Relationship between emissions growth and output growth



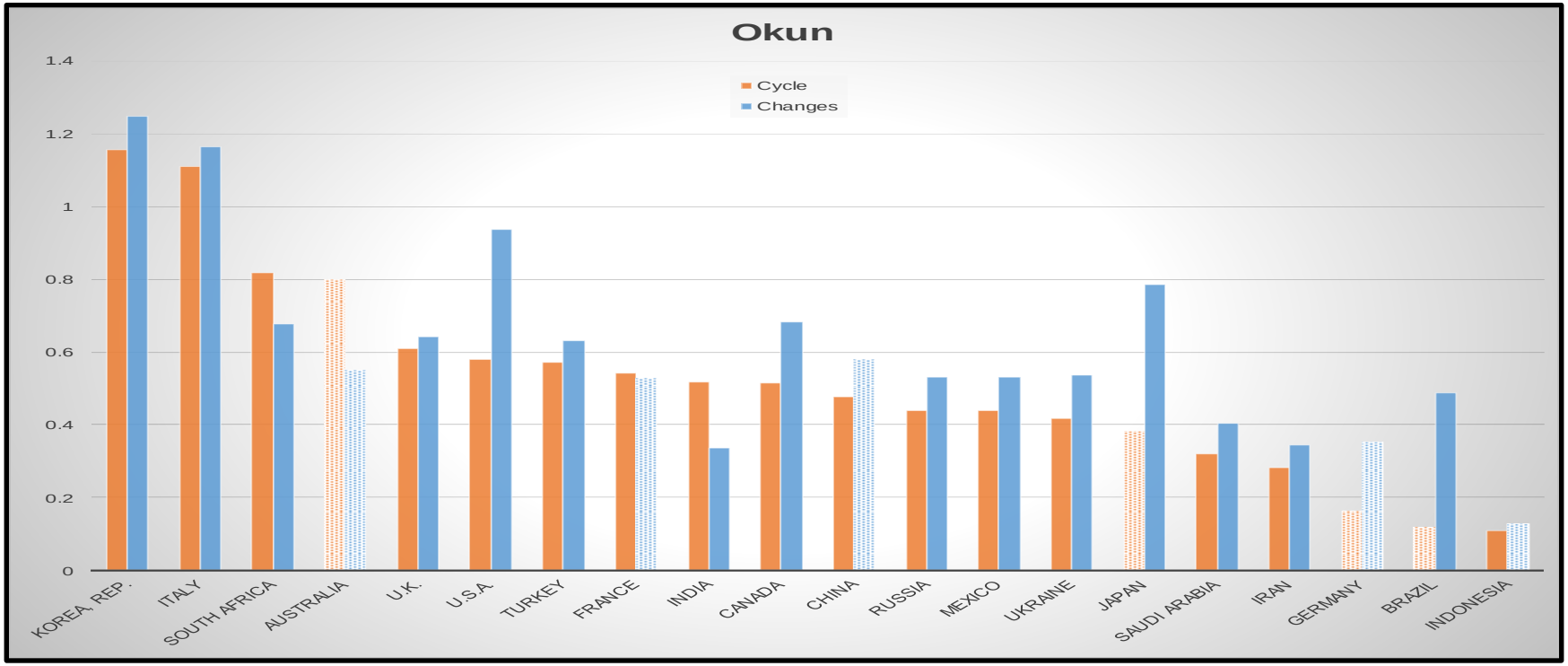
- As an analogy to the Okun's Law

$$\Delta e_t = \alpha + \omega \Delta y_t + u_t$$

Is there an Environmental Okun's Law?

- Okun (1962) documented a strong cyclical relationship between unemployment and real GDP (Okun's Law).
- Is there a similar law for cyclical fluctuations in emissions and GDP?
  - ***Question for discussion:*** to what extent does this come about by construction (i.e. is GDP data itself used to infer cyclical movements in emissions)?
  - Also, possibility of reverse causation: but presumably this does not happen at the cyclical frequency; plus, the bias would go the other way

Environmental Okun's Law: Estimates of the Okun Elasticities

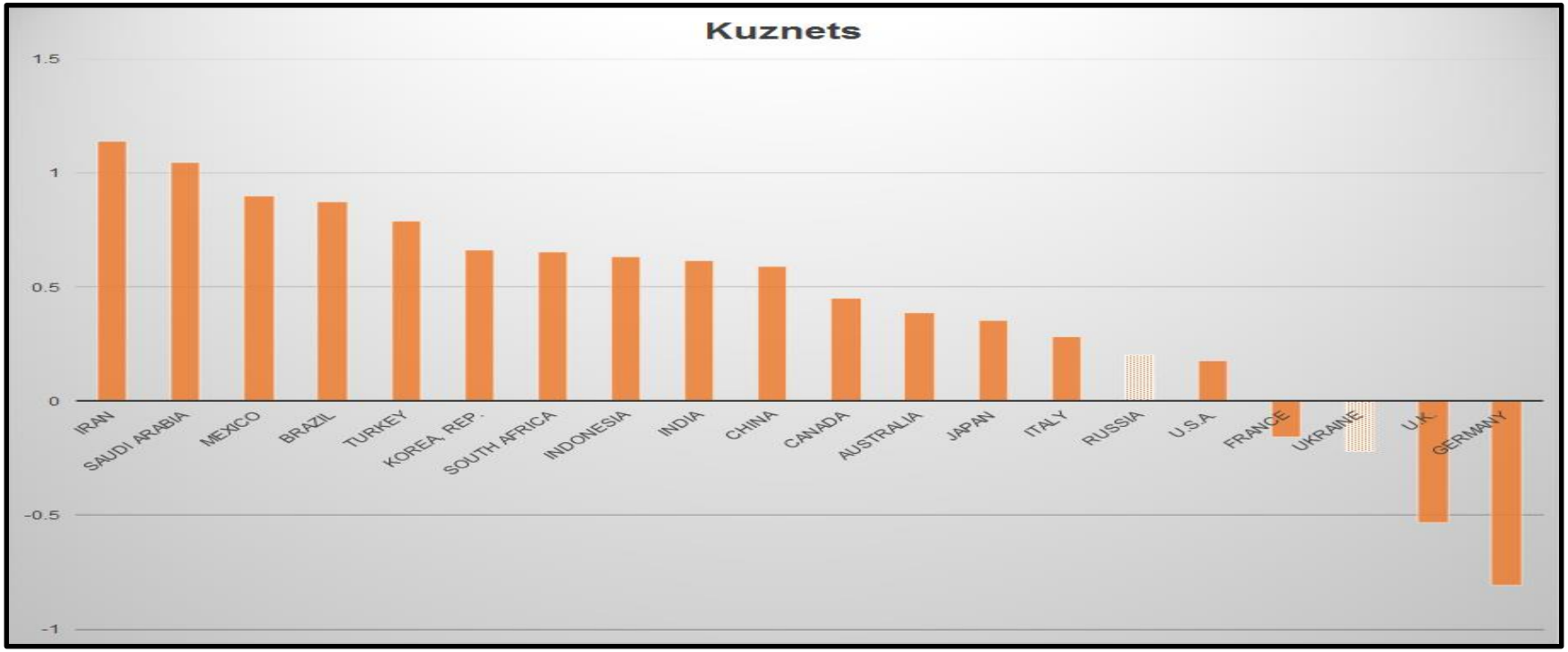


- Short-term elasticities

$$e_t^c = \beta^{\text{okun}}\, y_t^c + \varepsilon_t^c$$

- Estimation methods

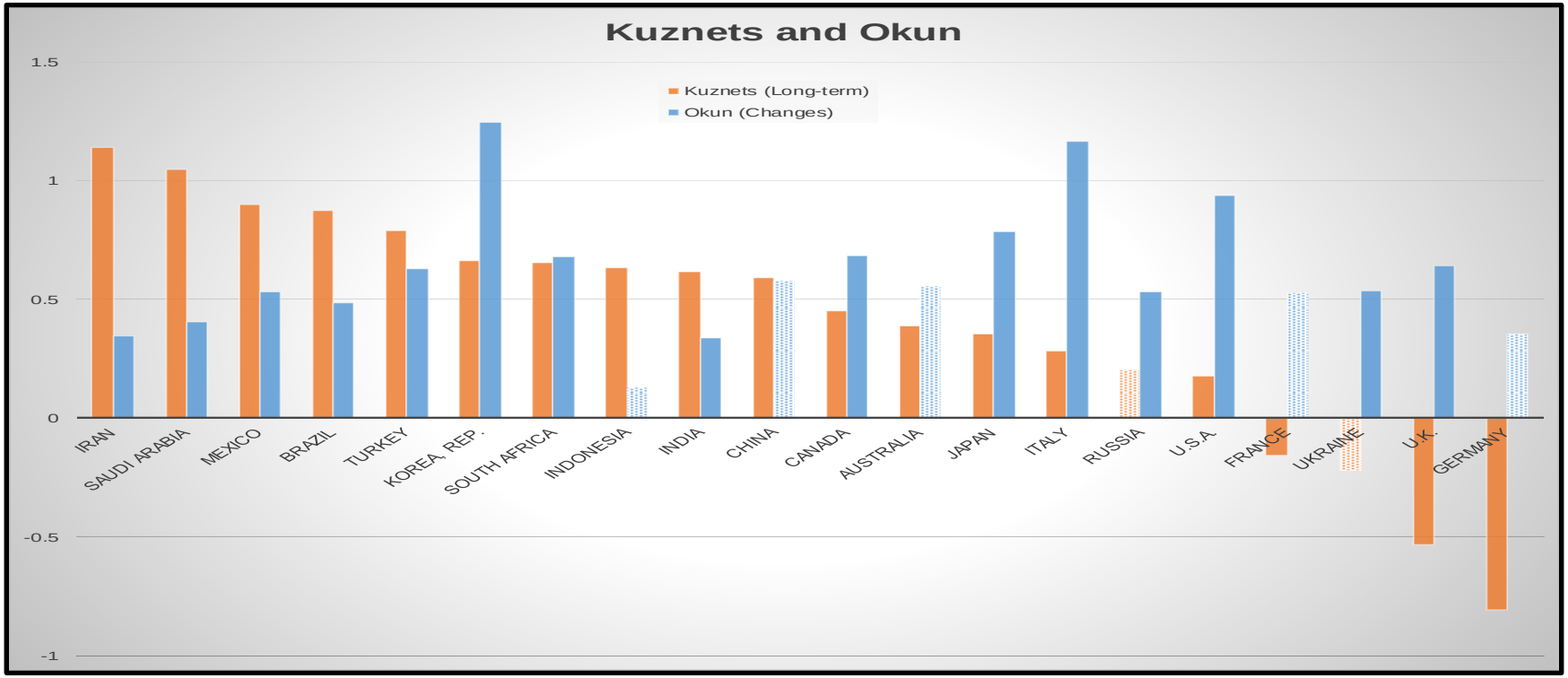
The Environmental Kuznets Curve: Estimates of the Kuznets Elasticities



- Long-term elasticities

$$e_t^{\tau} = \gamma \quad + \beta^{\text{kuznets}}\ y_t^{\tau} + \varepsilon_t^{\tau}$$

Kuznets vs. Okun



- Long-term elasticities

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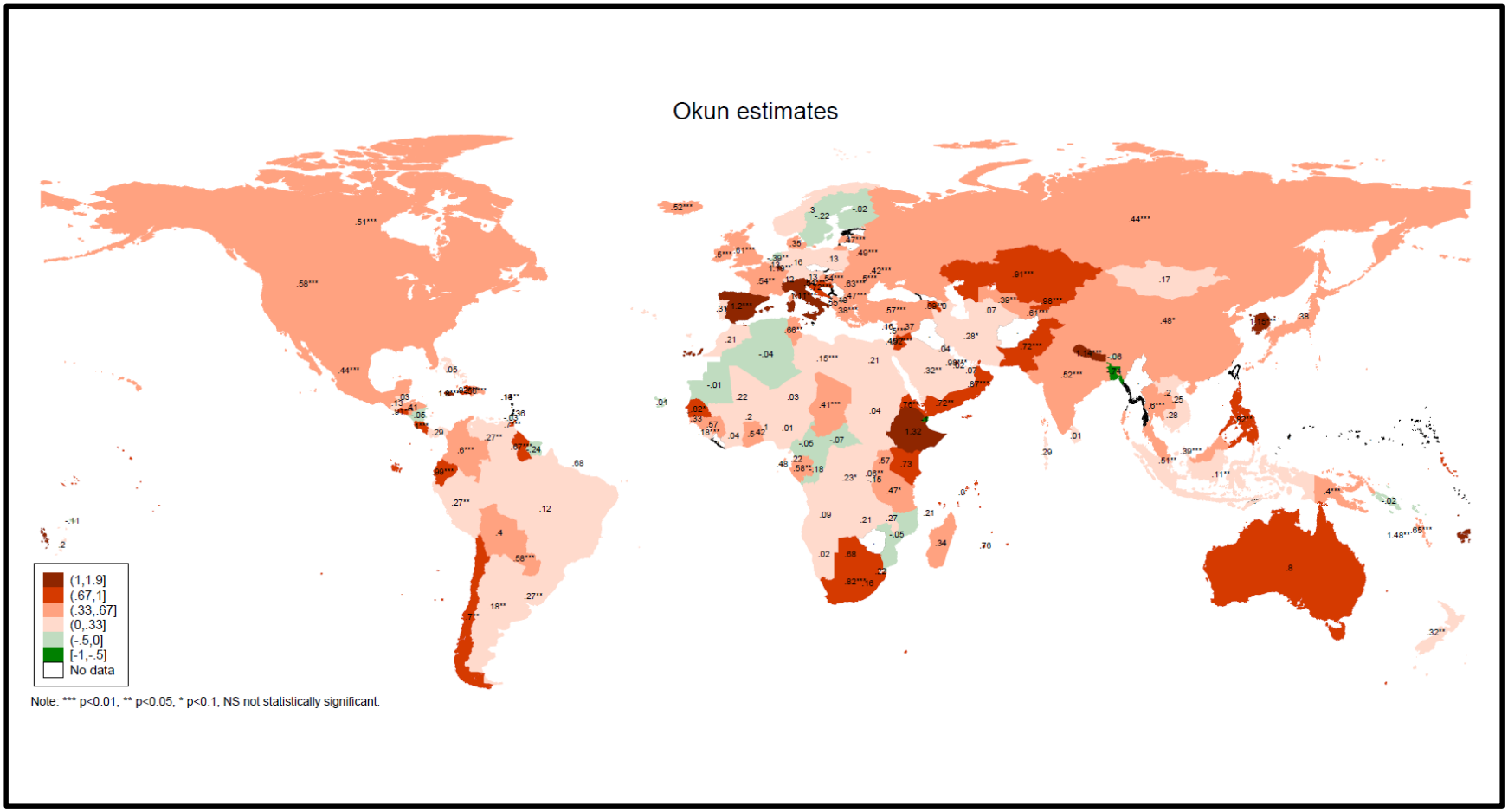
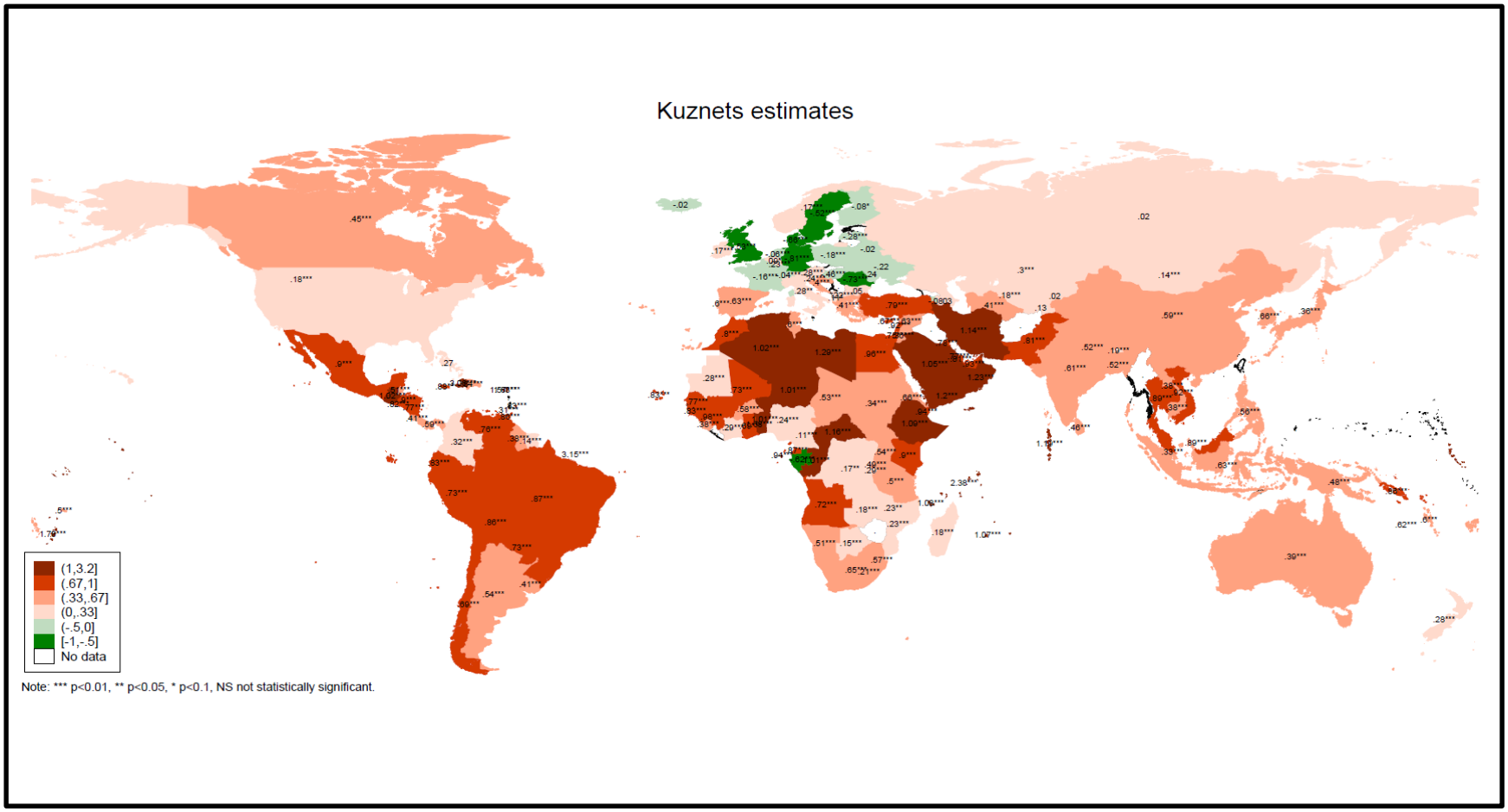
Okun elasticities around the world



Kuznets elasticities around the world



TRADE AND EMISSIONS

An integrated world

- So far, we have looked at the relationship between output and emissions at the production or territorial level.
  - However, in climate change terms, a unit of pollutant expelled to the atmosphere in the U.S. or China has on average the same effect on GHG concentrations.

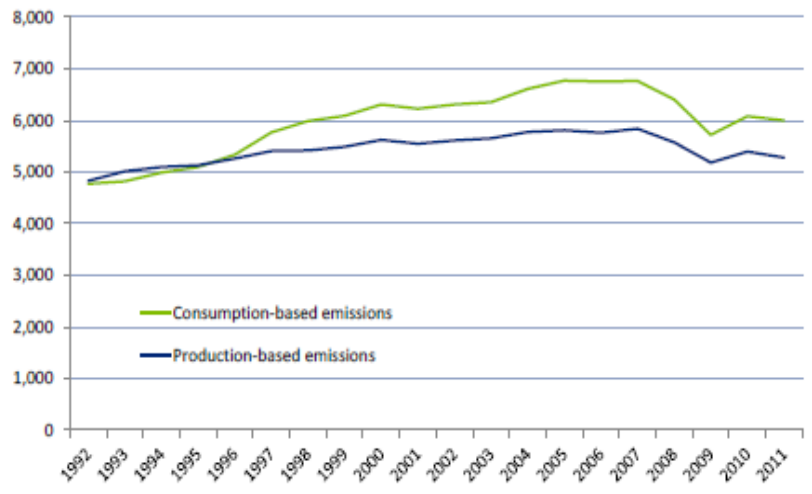
- In recent years, efforts are been made to develop consumption-based accounting of emissions to account for emission transfers via international trade

  - How does accounting for trade affect our Kuznets elasticity estimates?

Production and consumption-based emissions

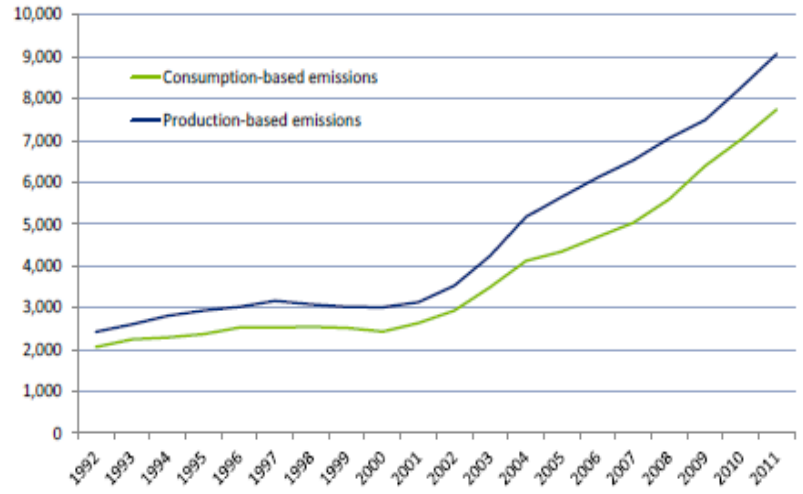
Higher consumption-based emissions

USA



Higher production-based emissions

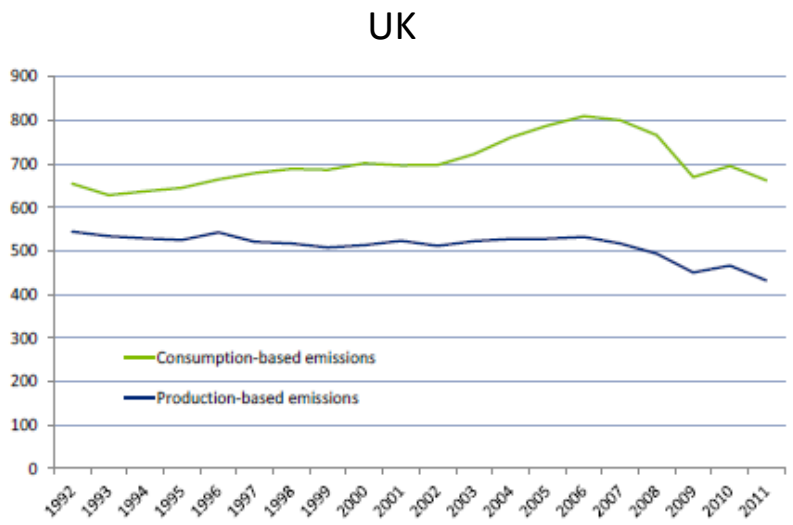
China



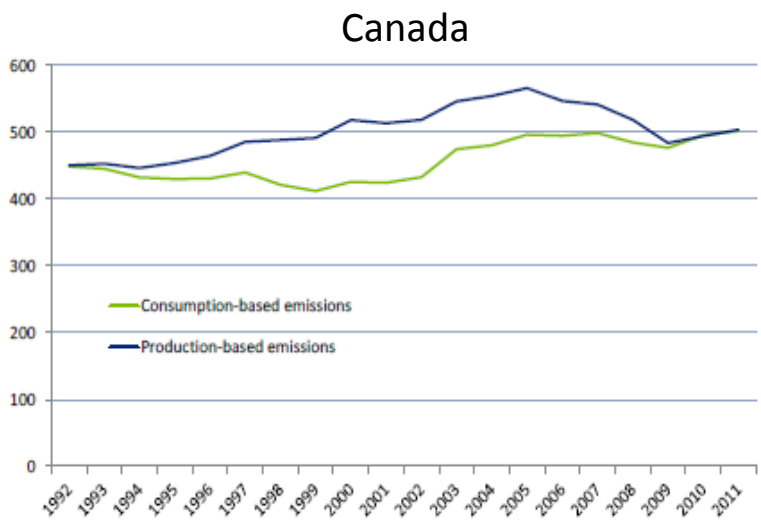
Source: Eora MRIO. Note: in Mt CO2.

Production and consumption-based emissions

Higher consumption-based emissions

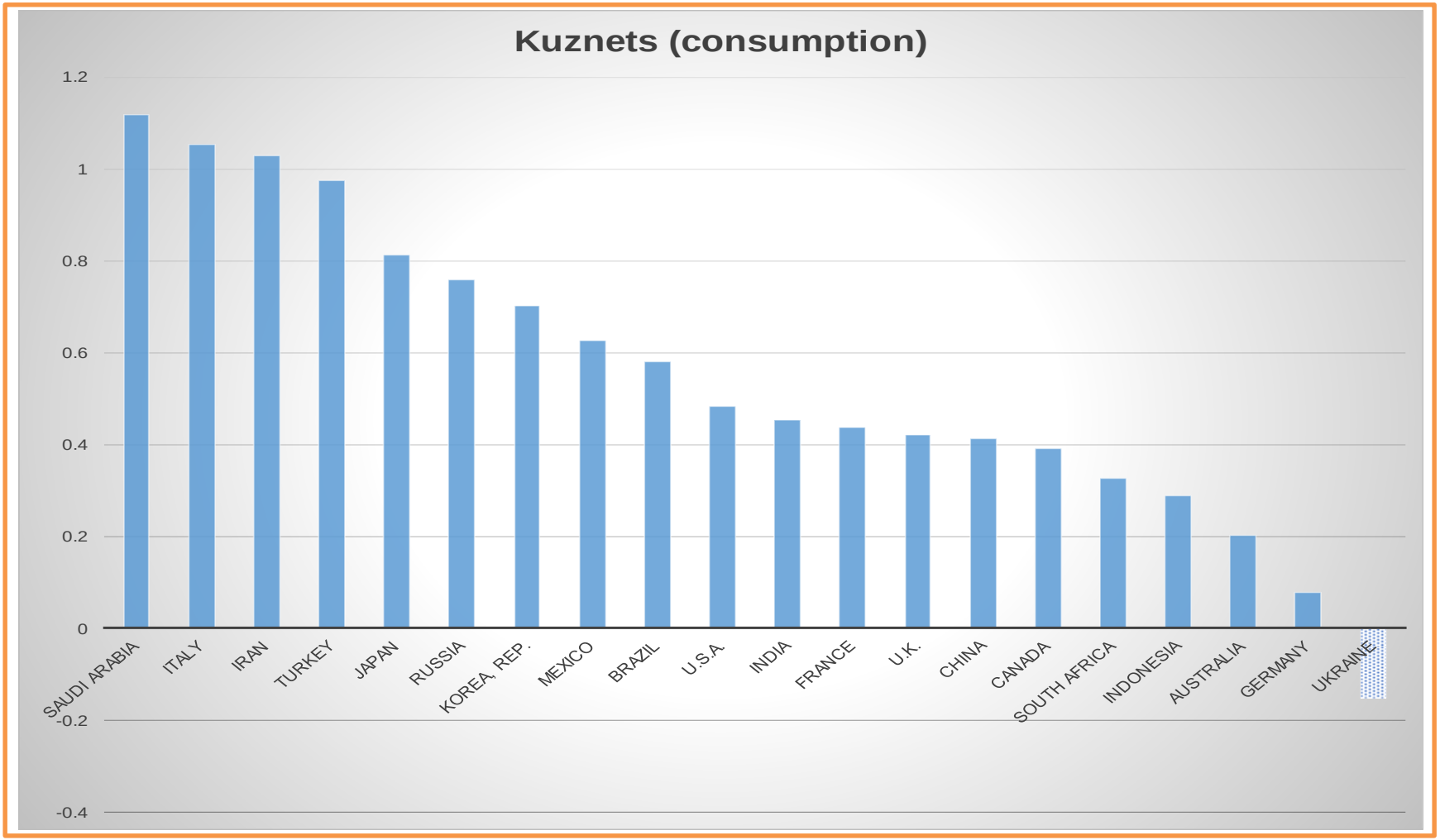


Higher production-based emissions



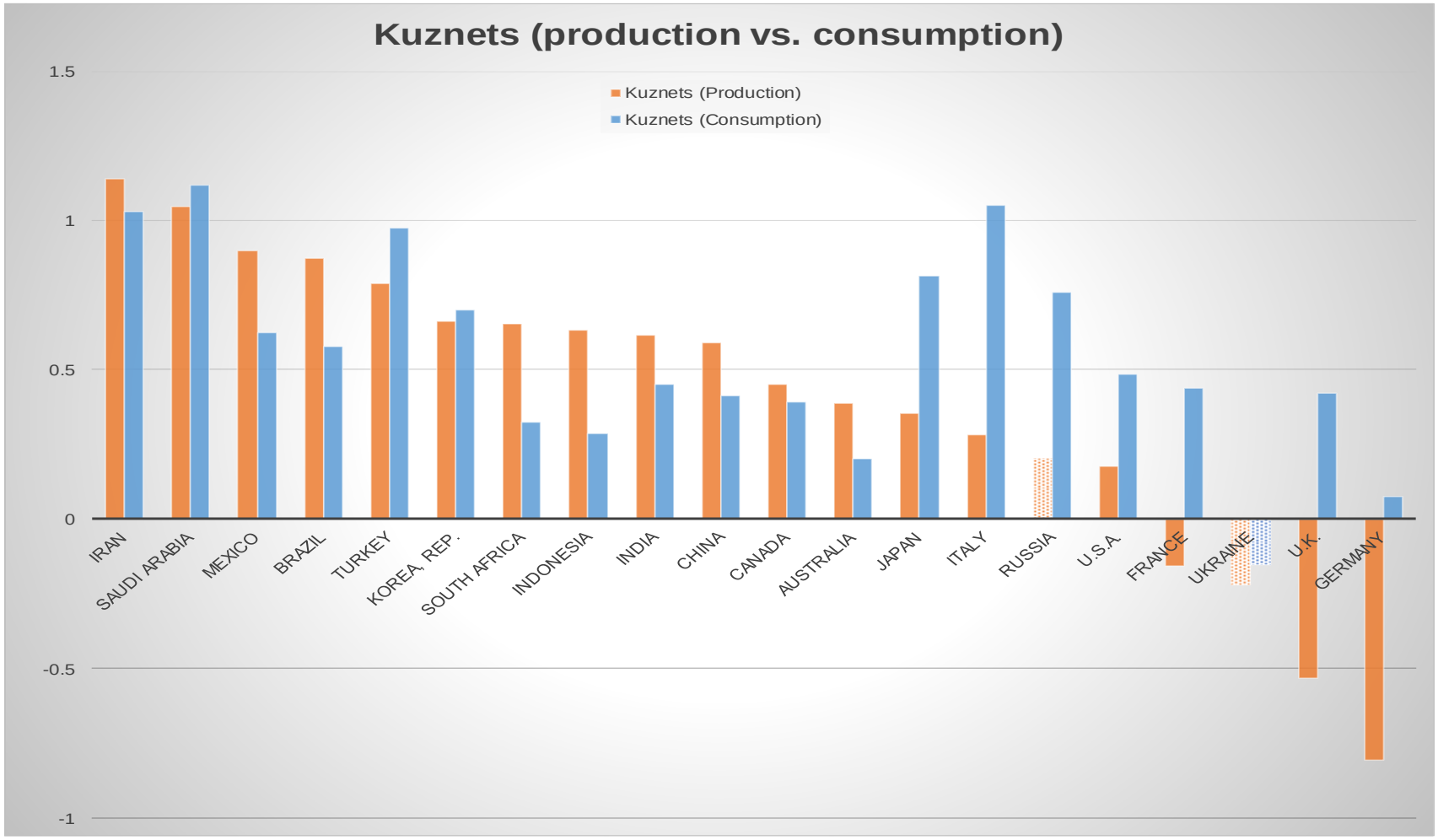
Revisiting Kuznets

(Consumption-based estimates)

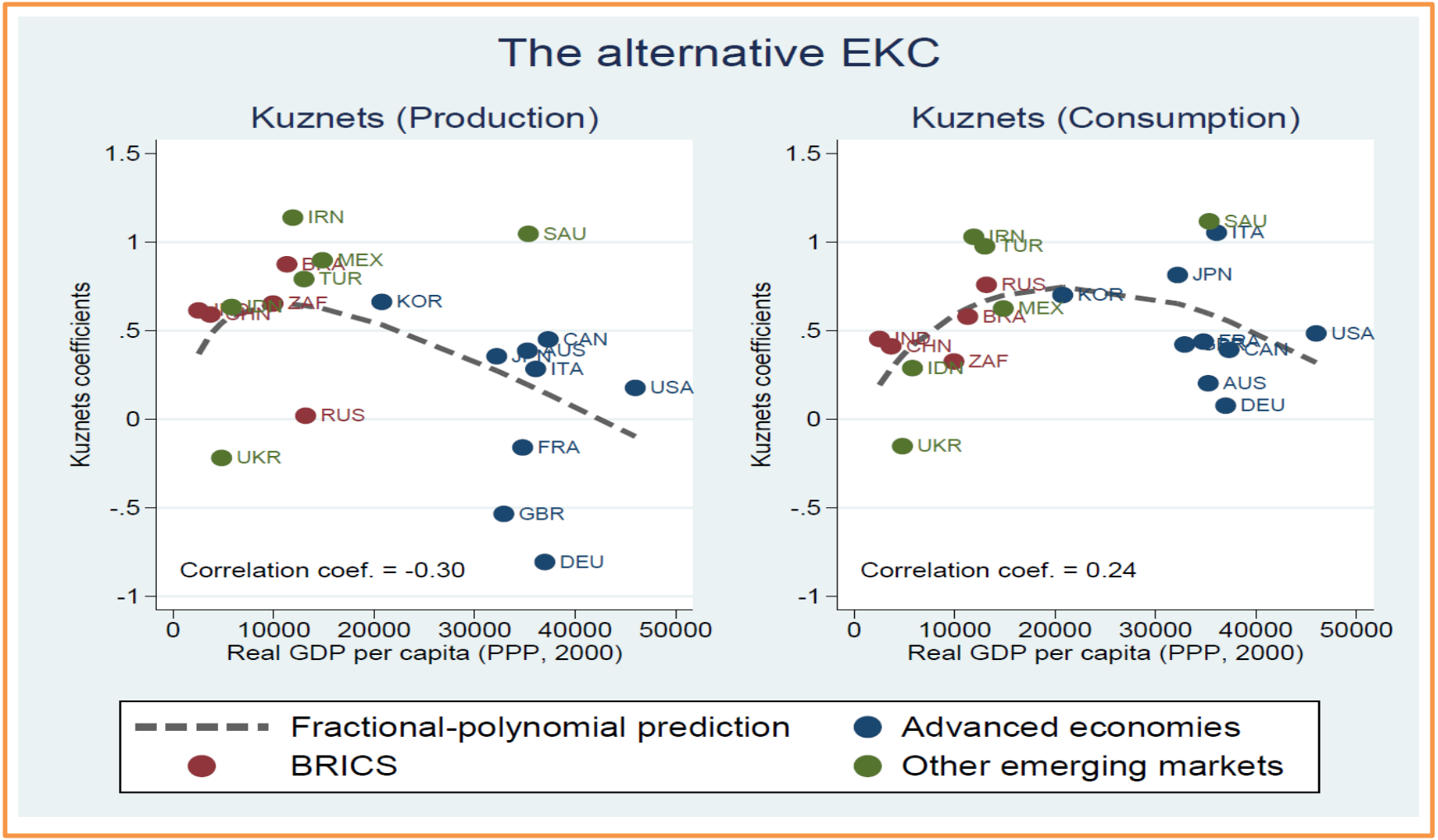


Revisiting Kuznets

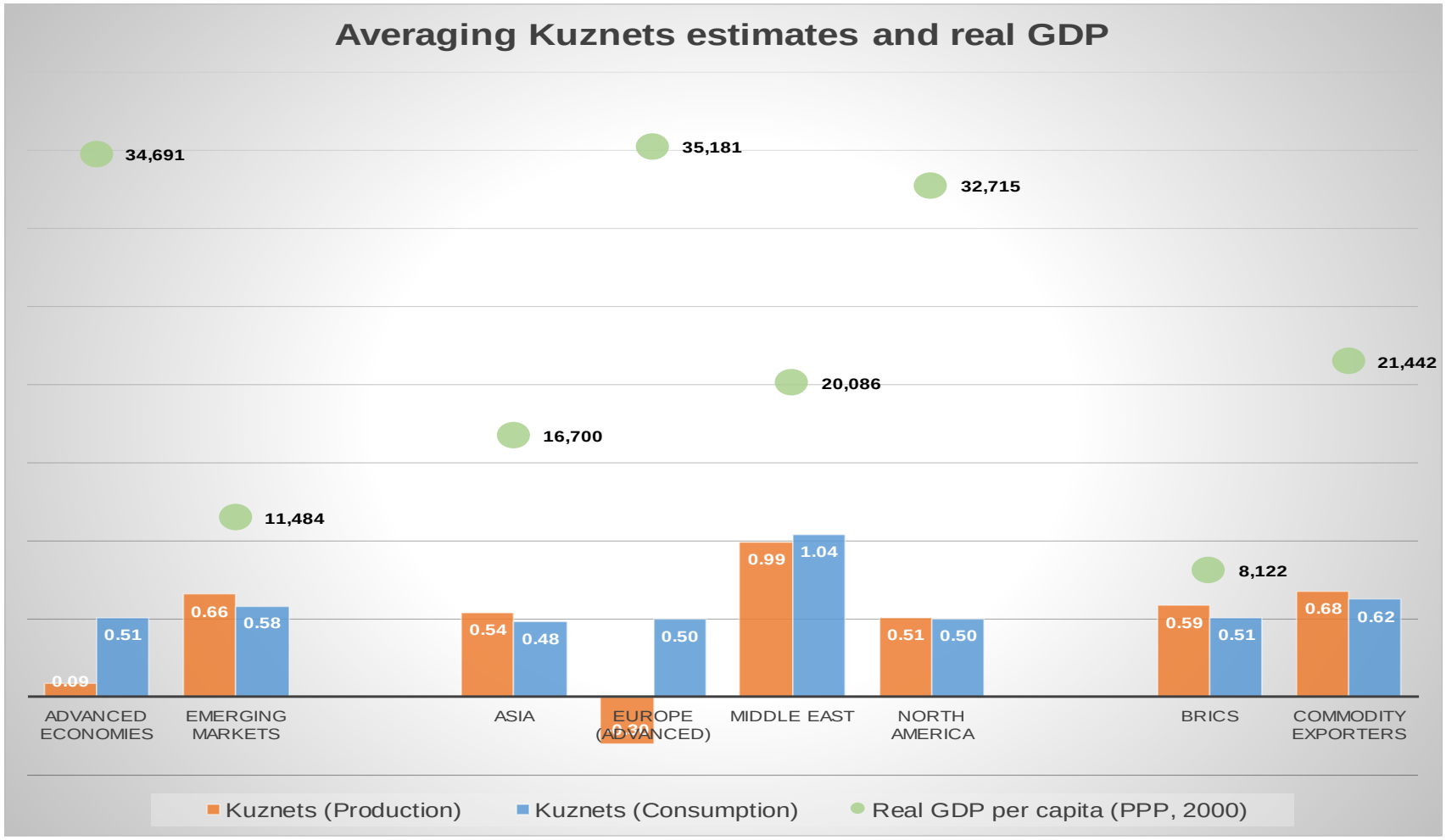
(Production vs. consumption-based estimates)



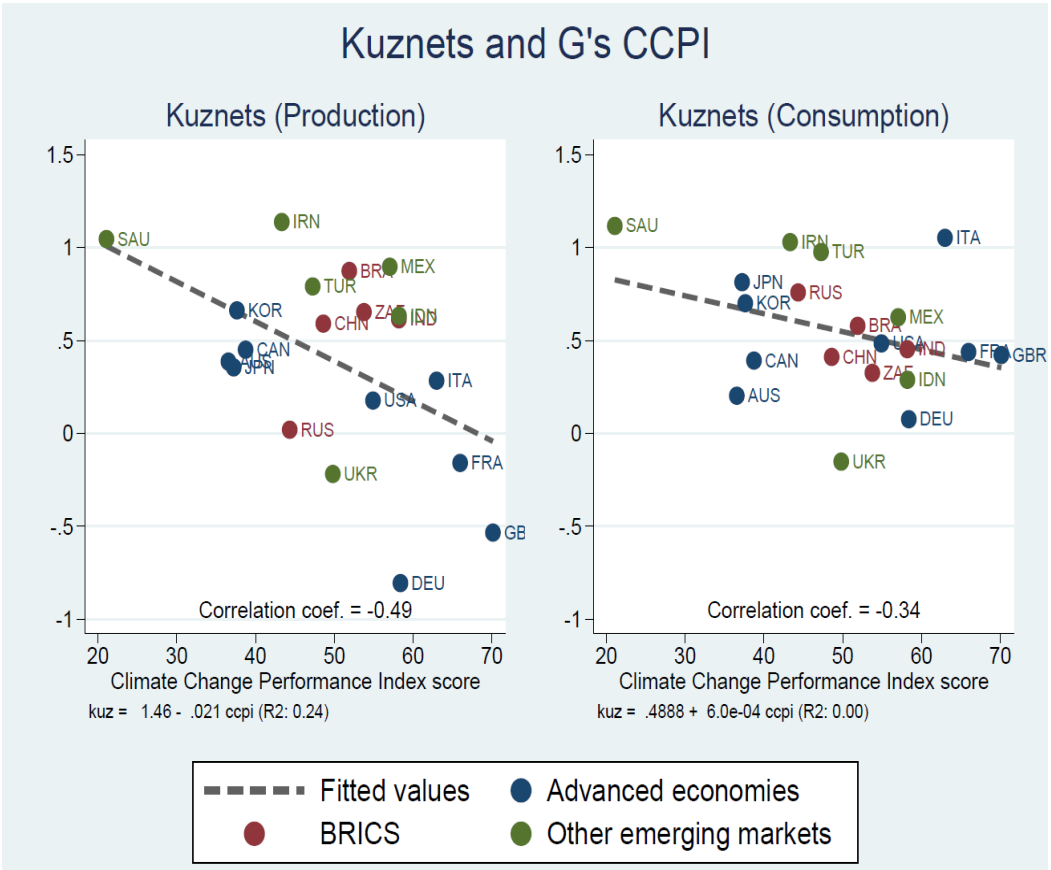
Kuznets elasticities & per capita GDP: Top 20 emitters



Kuznets elasticities and per capita GDP



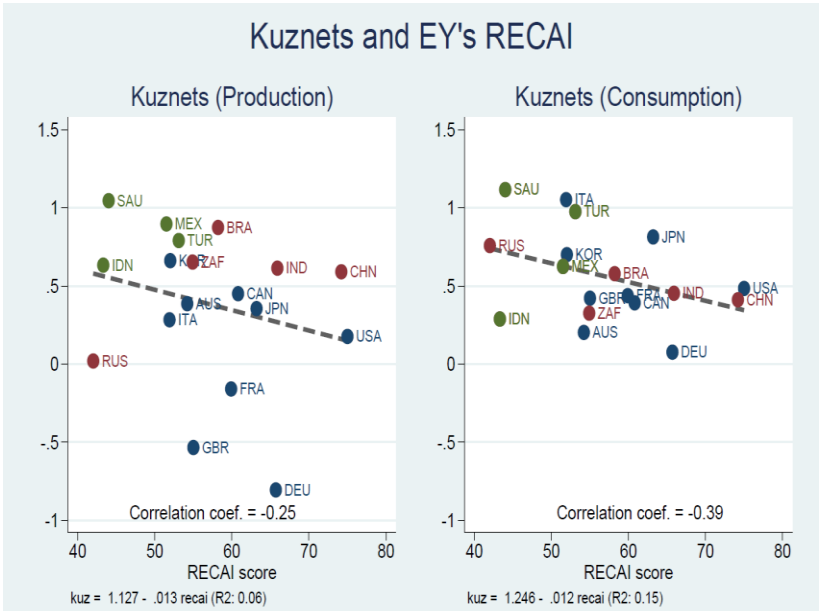
Policy environment and Kuznets

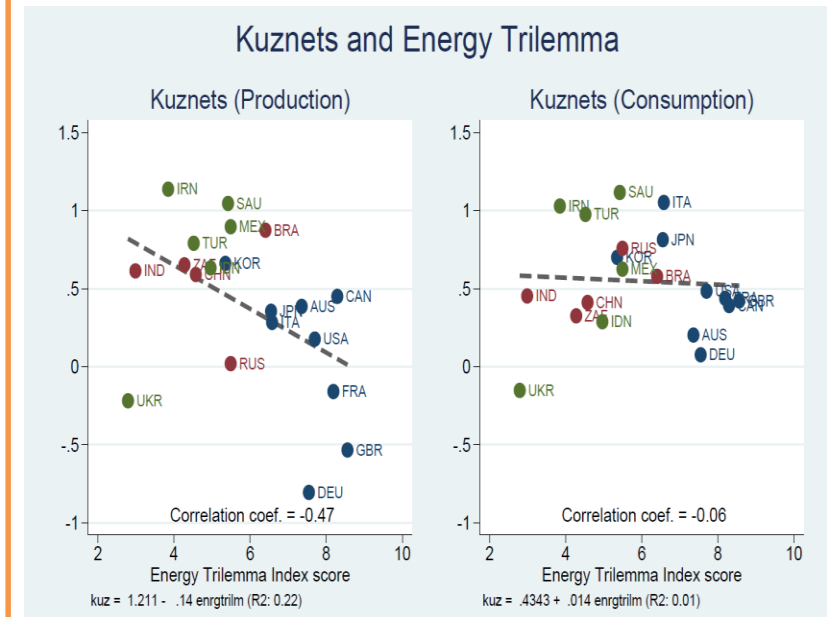


Measures: i) Germanwatch Climate Change Performance Index, ii) EY Renewable Energy Attractiveness Index, iii) WB CPIA environmental sustainability index, iv) World Energy Council Trilemma Index.

- **Measure of environmental policy setting** capturing the relative attractiveness and quality of climate change policies.
- **Policy environment matters for both long-run elasticities**: well-ranked countries tend to have lower (Production and Consumption) Kuznets.
- **But not for short-run (Okun) elasticities**.

Policy environment and Kuznets





Issues for discussion

- Emissions, like GDP, move in cycles. Is the concept of an Environmental Okun's Law (EOL) useful? valid?
  - There is a strong cyclical relationship between emissions and output **(0.6 on average for each income group)**. Emissions could be temporarily low simply because the economy is in a downswing and temporarily high during a boom.
  - Is EOL just an endogenous construct? At cyclical frequency, are GDP fluctuations themselves used to construct the emissions data?
- Advanced economies have managed to transition to a low-carbon path but globalization may have played an important role
  - Kuznets coefficients differ greatly for production-based & consumption-based emissions. Implications for climate change agréments?
- How to compare gains from trade to the losses from impact of trade on the environment?