Global value chains and GHG emissions

Neil Foster-McGregor and Bart Verspagen

Work in progress!

The aim of the analysis

Without international trade, what a country consumes determines what it emits

But GVCs change this picture: what a country consumes emits domestically and abroad

In other words, territorial emissions are different from footprints

If we want to debate fairness and an equitable distribution of global emissions, we need to know if the difference between footprints differs systematically with the level of development of nations

Methods

Global Value Chains and input-output economics: decomposition of per capita emissions (*territorial* or *footprint*) into 3 factors

This is reminiscent of the Kaya identity (IPAT: Impact = Population × Affluence × Technology), but with a *different twist*

Relate the decomposition results in a country panel to the development of living standards (GDP per capita)

Emission drivers in our framework

- Technological change: innovation and diffusion of best-practice, leading to a fall in emissions per unit of production
  - Renewable energy, energy efficiency, various CC forms, electrification
- Increase of living standards (leading to more emissions)
- Structural change: evolution of production and consumption towards goods and services with more/less emissions
- Trade in GVCs: shift of production towards more/less emission intensive locations

Data

- OECD MRIO (ICIO): 76 countries + ROW, 45 sectors, 1995 – 2020
- Only emissions from combustion
- Emissions per capita
  - "production-based" → territorial
  - "demand-based" → footprint

The GHG-GVC matrix

|		Using countries				
		AUS	AUT	...	VNM	ROW
Emitting countries	AUS					
	AUT					
	...					
	VNM					
	ROW					

The share of "traded" emissions in the 76 countries global total
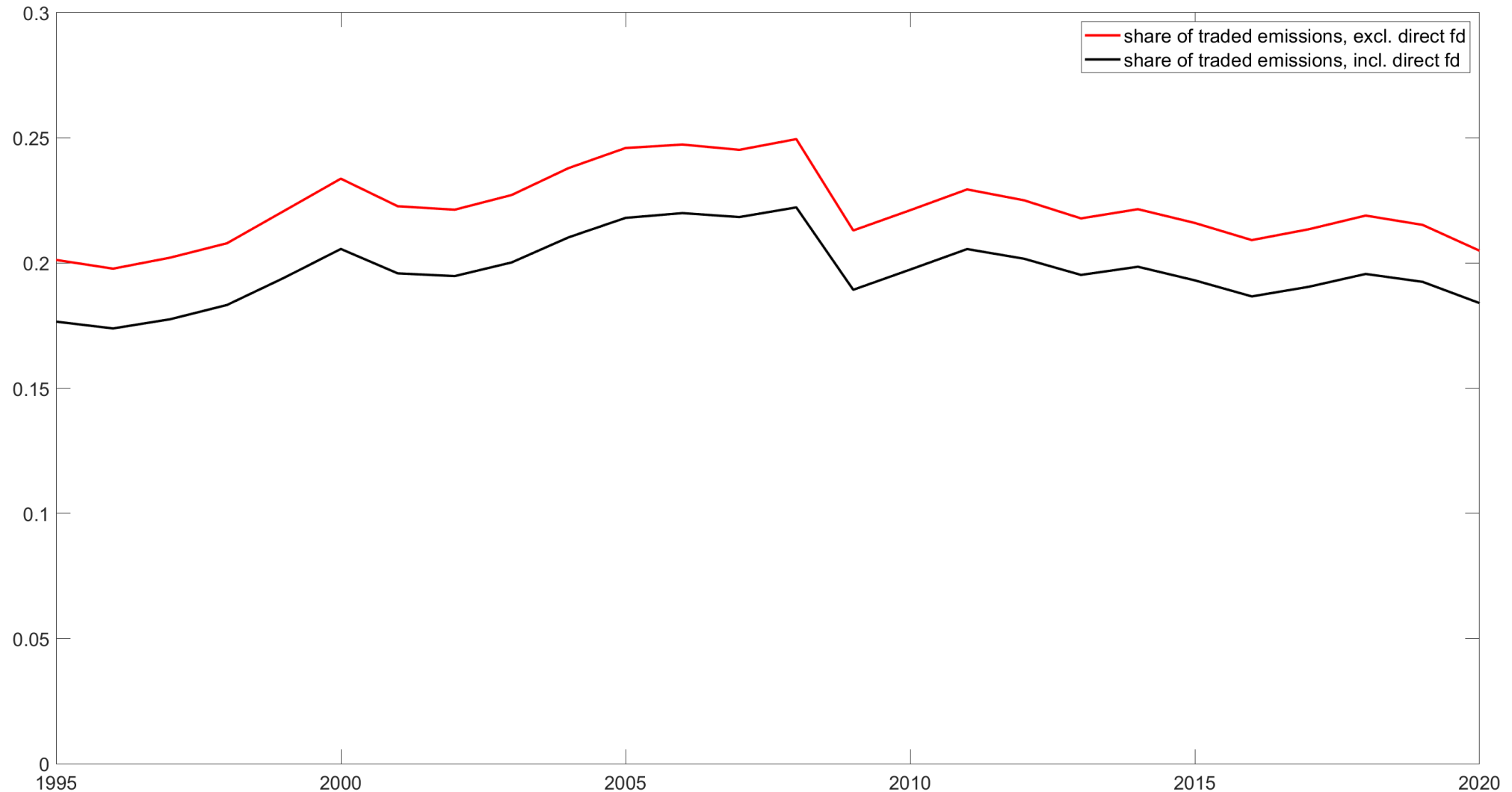
Decomposing per capita emissions (territorial and footprint)

- **Intensity vs Affluence**: the combined effect of changes in emissions per unit of gross output ("intensity") and per capita final demand (consumption and investment; "affluence")
  - E.g., if emissions per unit of output fall faster than per capita final demand rises, emissions will fall

- **Structural change**: changes in the composition of final demand and/or intermediate use towards products or services that emit more/less

- **Trade**: buying products or services (for final demand and/or intermediate use) from locations that emit more/less

# Decomposition of global emissions (per capita; territorial = footprint)
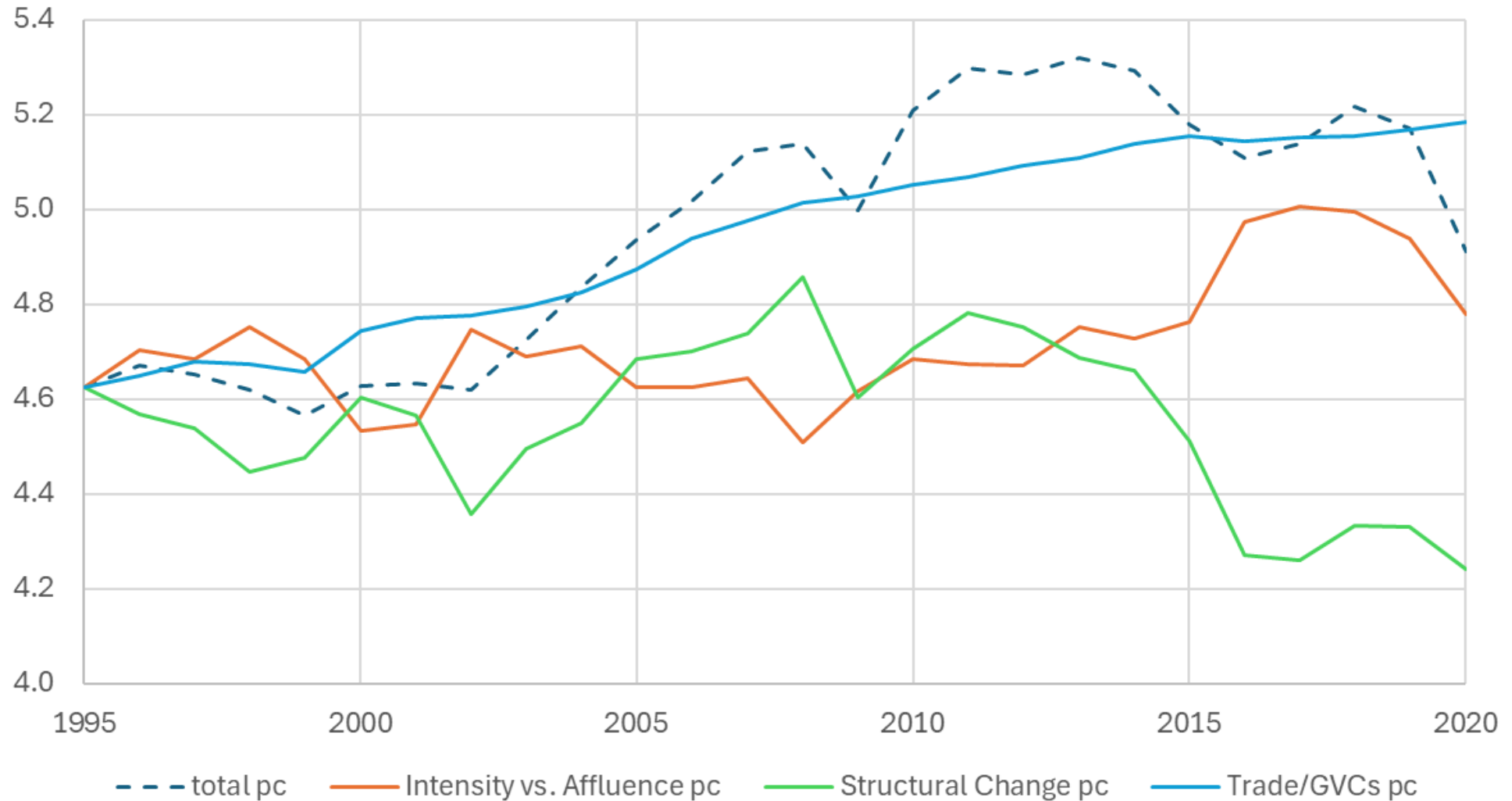
Net exports of embodies emissions

- Territorial emissions minus the emission footprint (both in per capita terms)
  - How do net imports/exports relate to development level (per capita income)?
    - Do poor countries export embodied emissions and do rich countries import them?
  - Does this relationship change over time?

- If we apply the decomposition to this difference, we will have 4 factors: the initial (1995) difference and the 3 decomposition factors

Time series for some example countries (tonnes per capita)
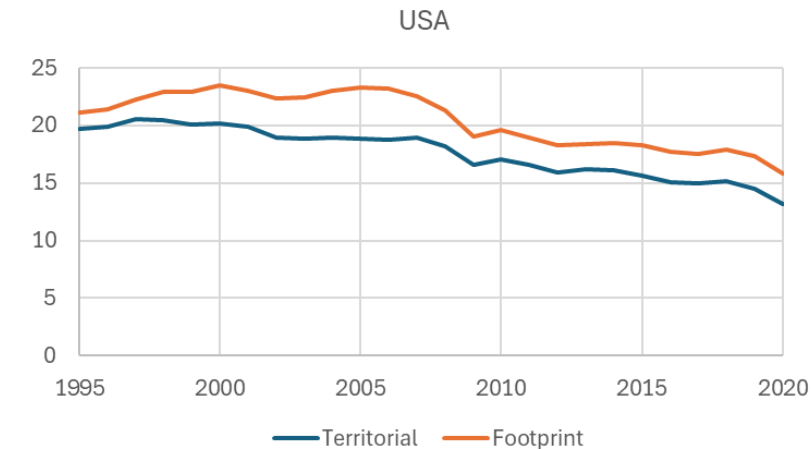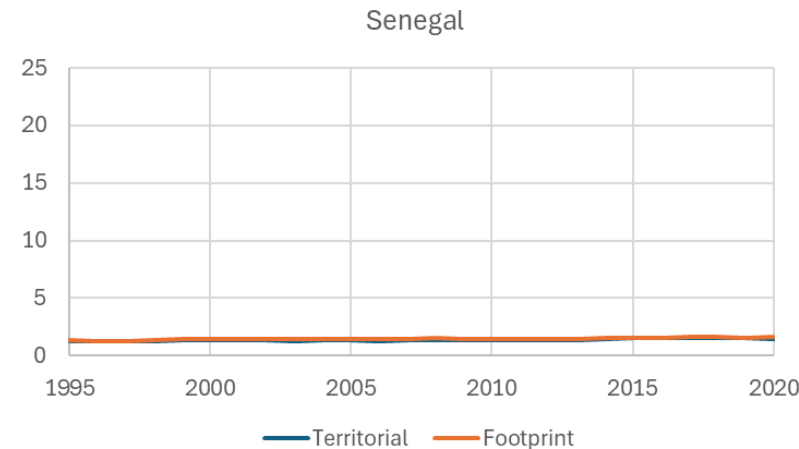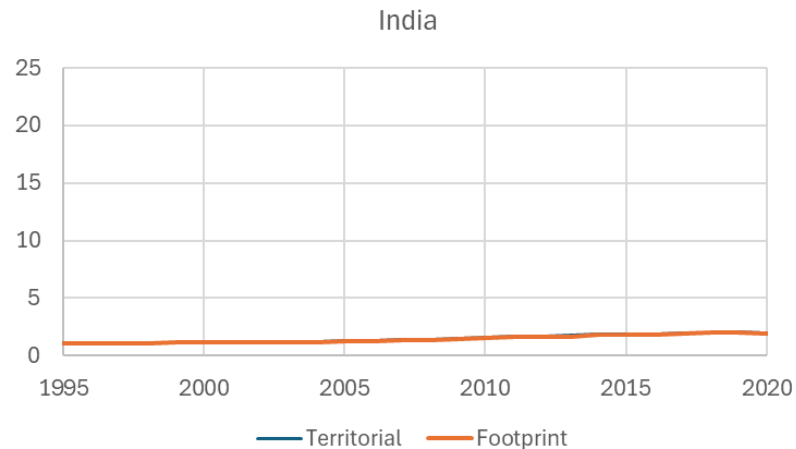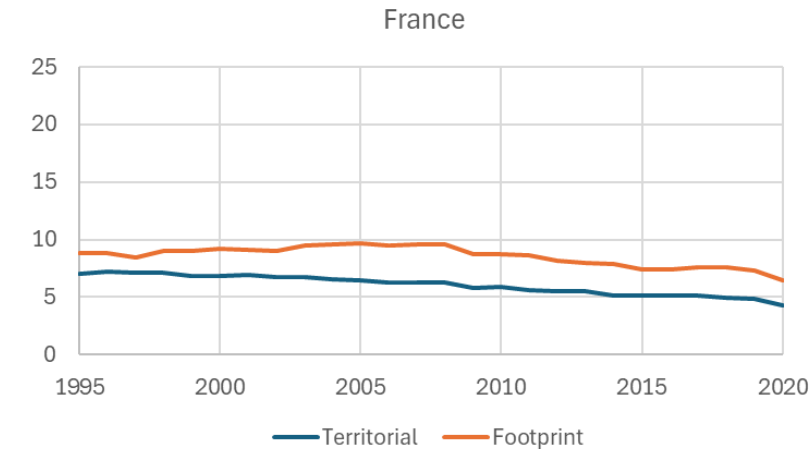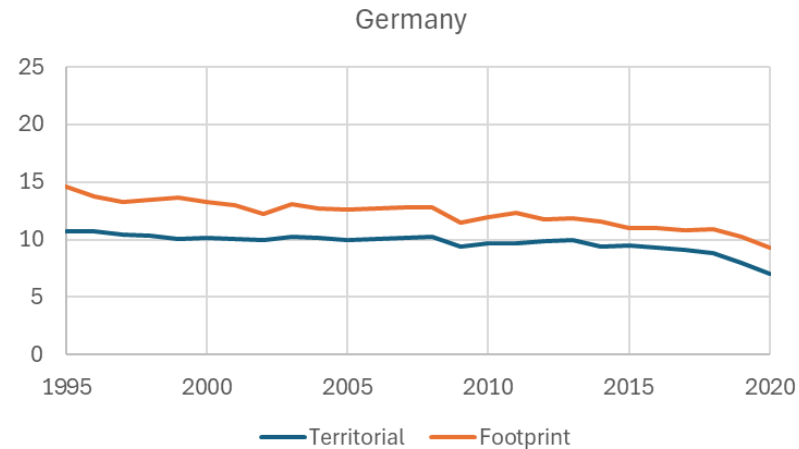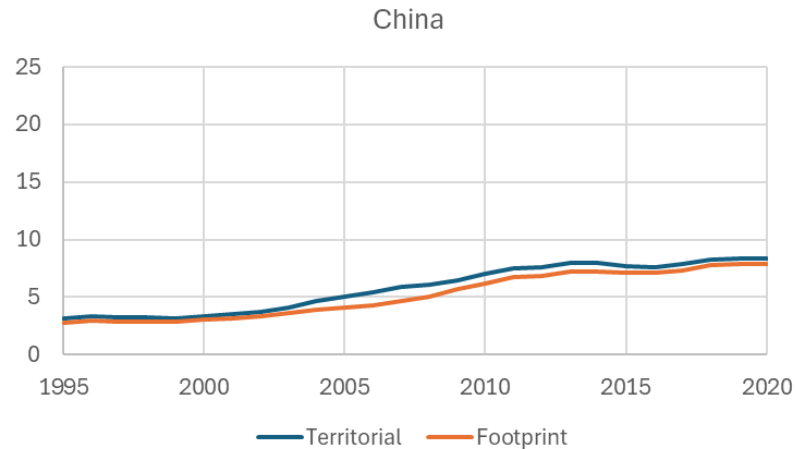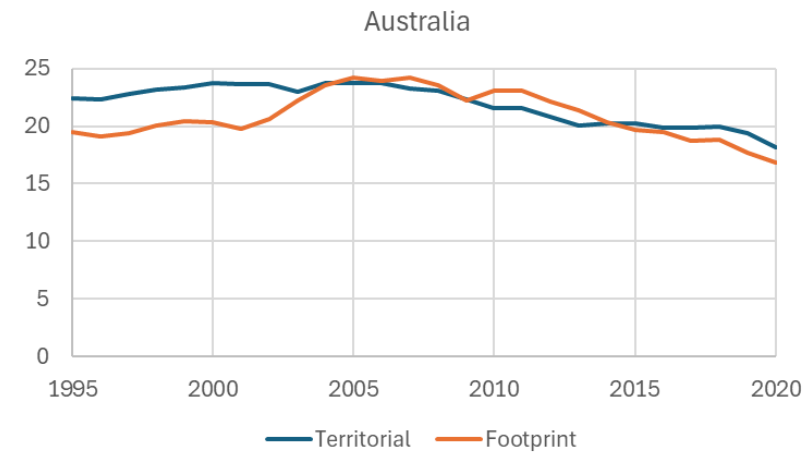
Net exports trends (of absolute values): Intensity vs Affluence and Trade matter most
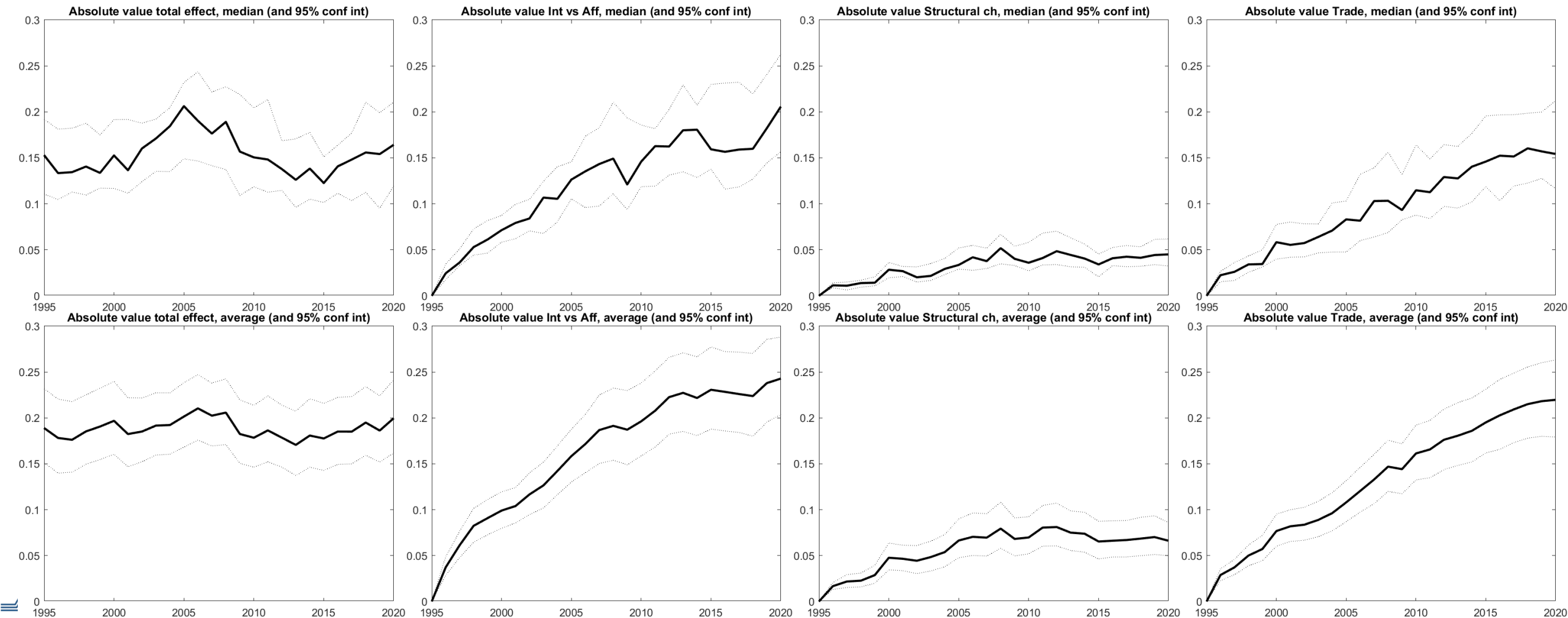
# How the decomposition effects depend on various changes in the IO table

	Change of an emission coefficient in A	Change of volume of final demand in A	Change in the structure of input coefficients in country A	Change in trade shares of intermediate inputs in country A	Change in the structure of final demand in country A	Change in trade shares of final demand in country A
Territorial – Int vs. Aff	Only country A changes	All countries change				
Territorial – Structural change			All countries change		All countries change	
Territorial – Trade				All countries change		All countries change
Minus:						
Footprint - Int vs. Aff	All countries change	Only country A changes				
Footprint – Structural change			All countries change		Only country A changes	
Footprint – Trade				All countries change		Only country A changes

Let's look at time series for a few countries

Int vs. Affl is negative can mean:

(1) positive value at footprint side dominates (e.g., China, Vietnam) → final demand in the country grows faster than emission intensity in the supplying countries falls

(2) Negative value at the territorial side dominates (e.g., Czechia, Estonia) → emission intensity in the country falls faster than final demand for the country rises
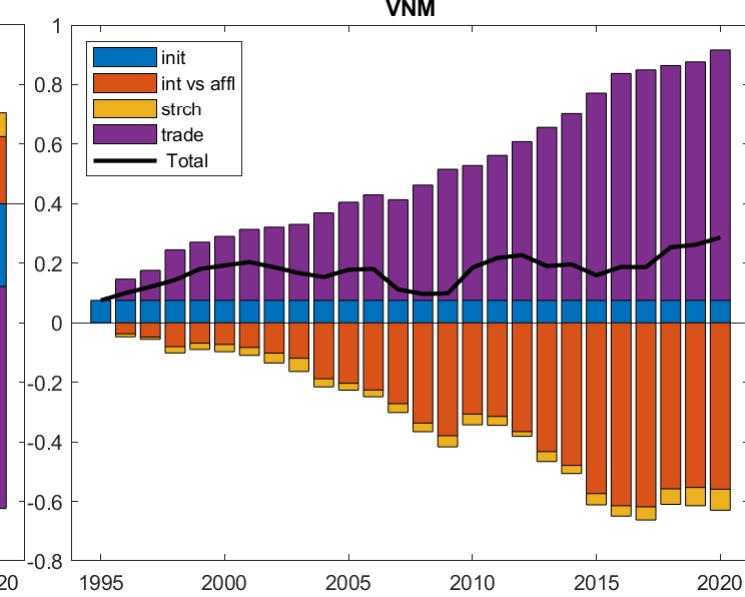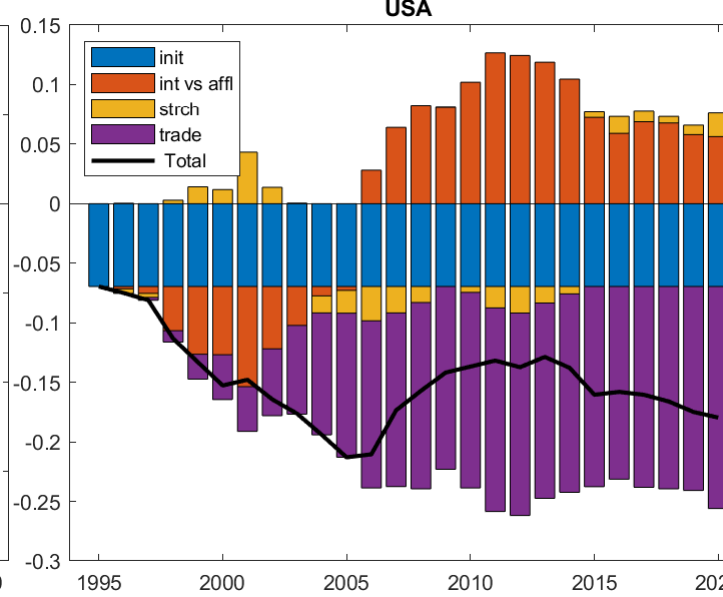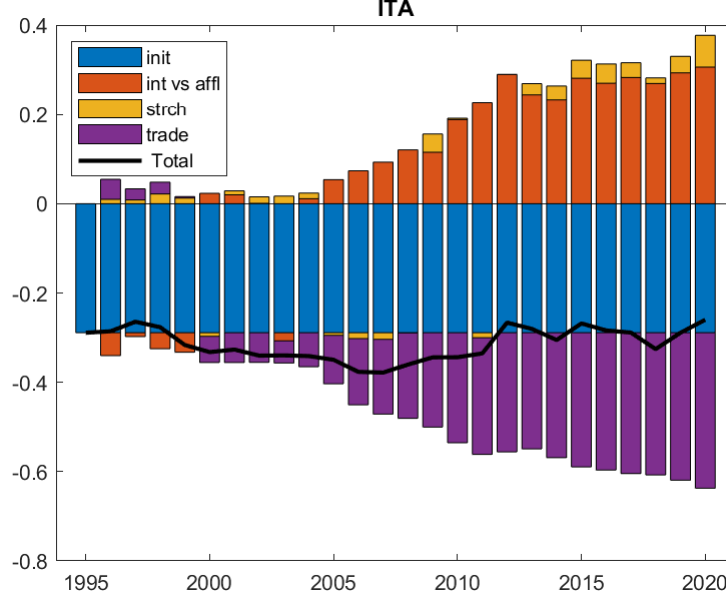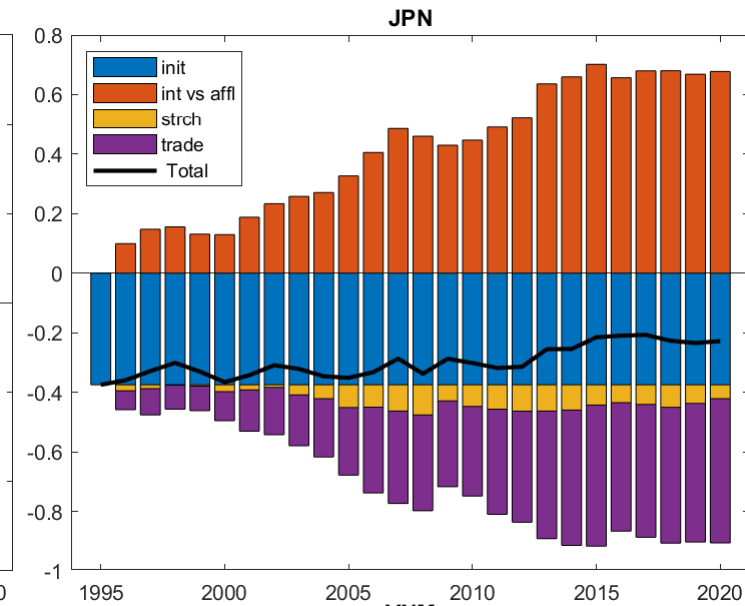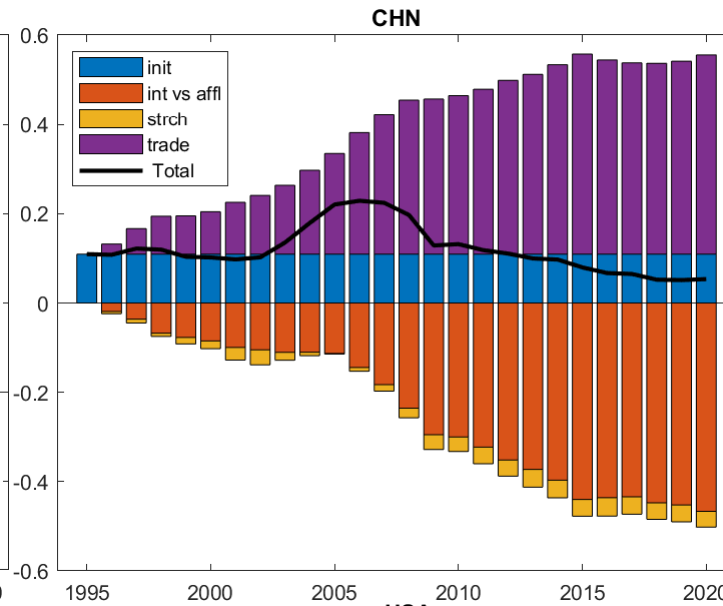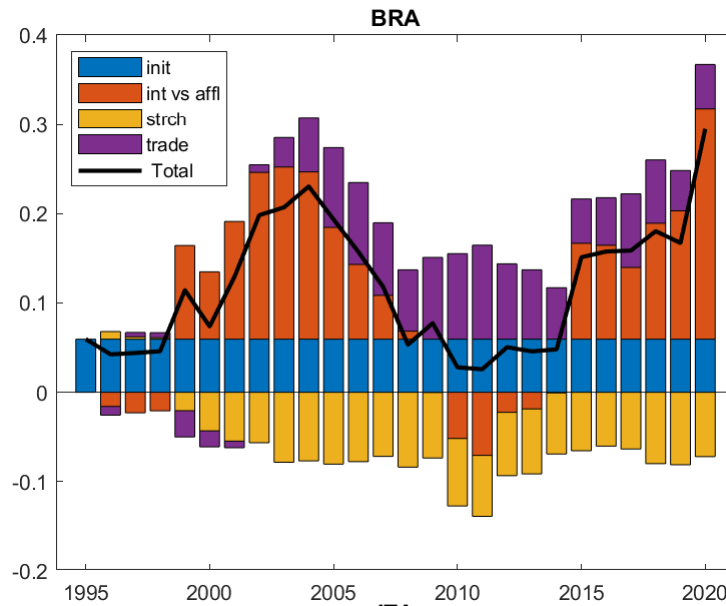
Let's look at time series for a few countries

Int vs. Affl is positive can mean:

(1) positive value at territorial side dominates (e.g., Croatia, Korea) → final demand in buying countries grows faster than emission intensity in the country falls
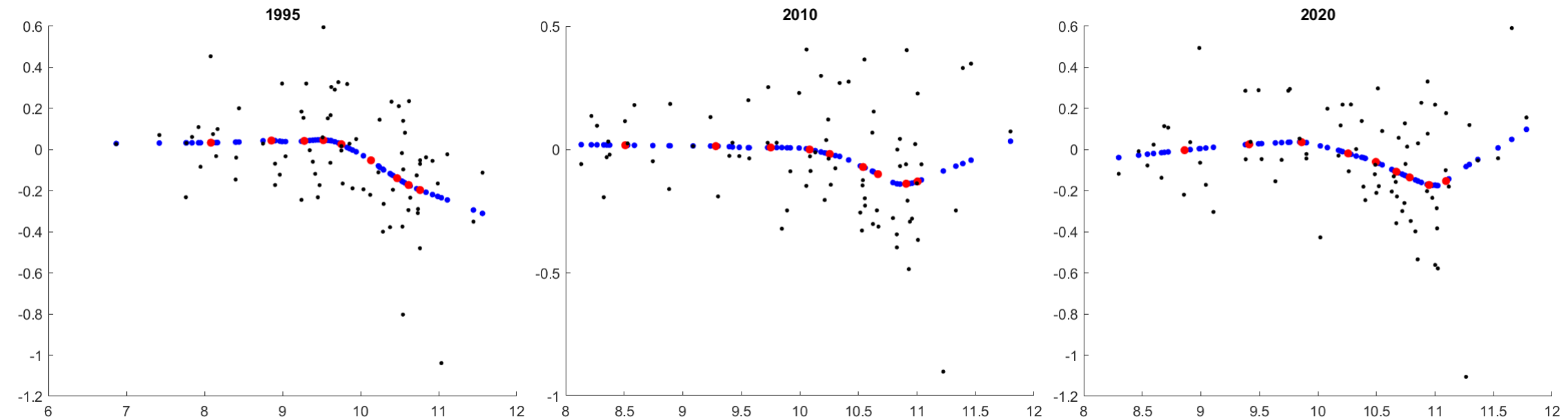
(2) Negative value at the footprint side dominates (e.g., Switzerland, Hongkong) → emission intensity in supplying countries falls slower than final demand in the country rises
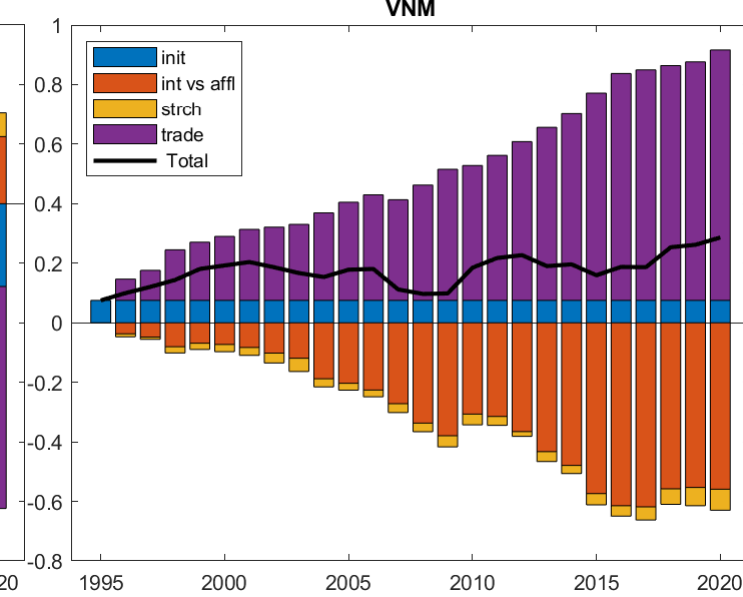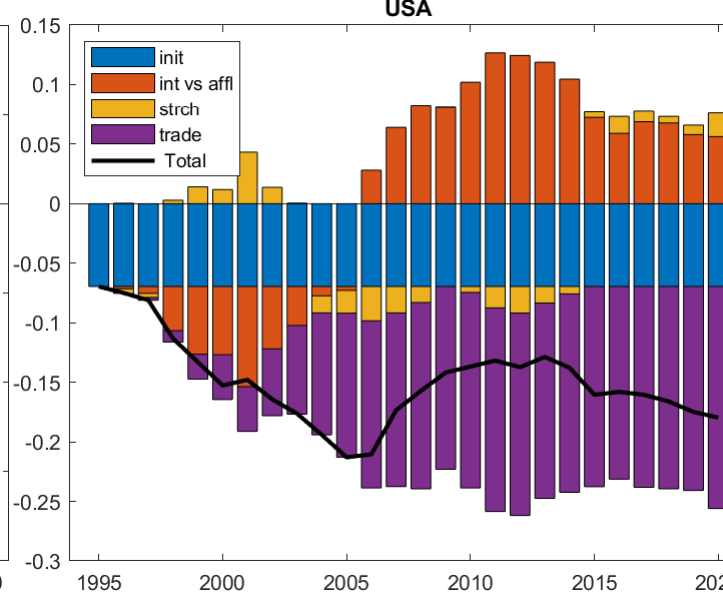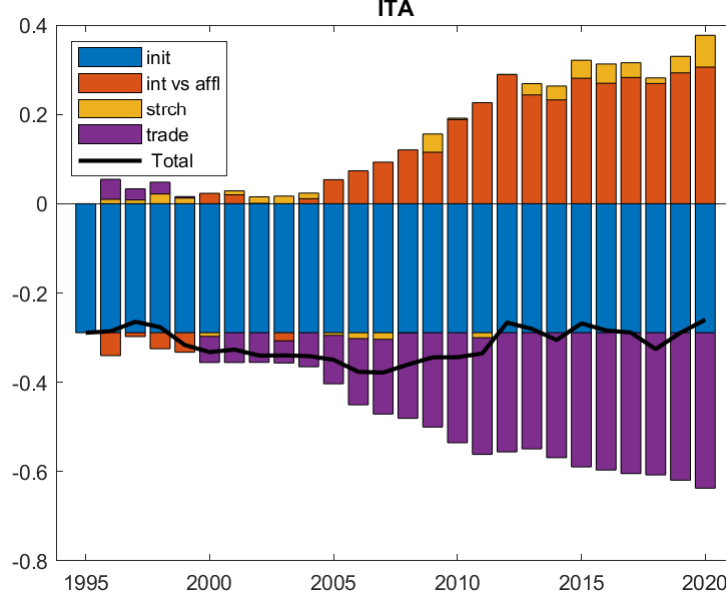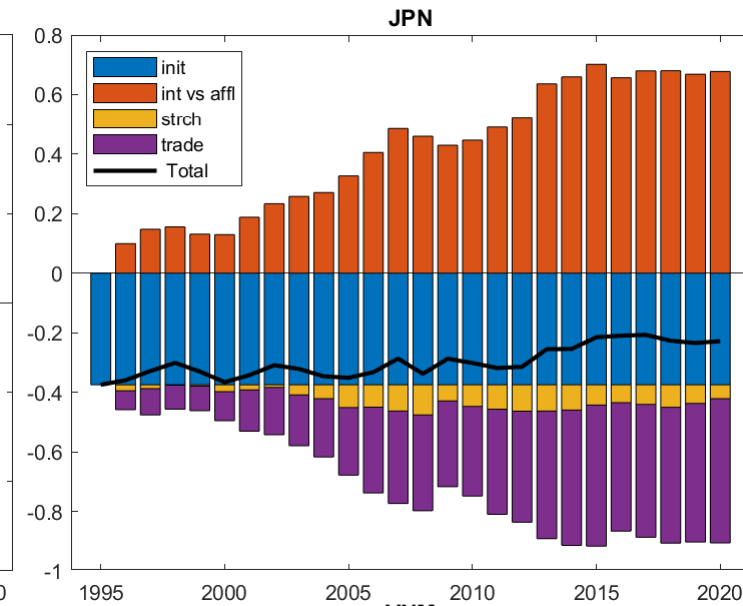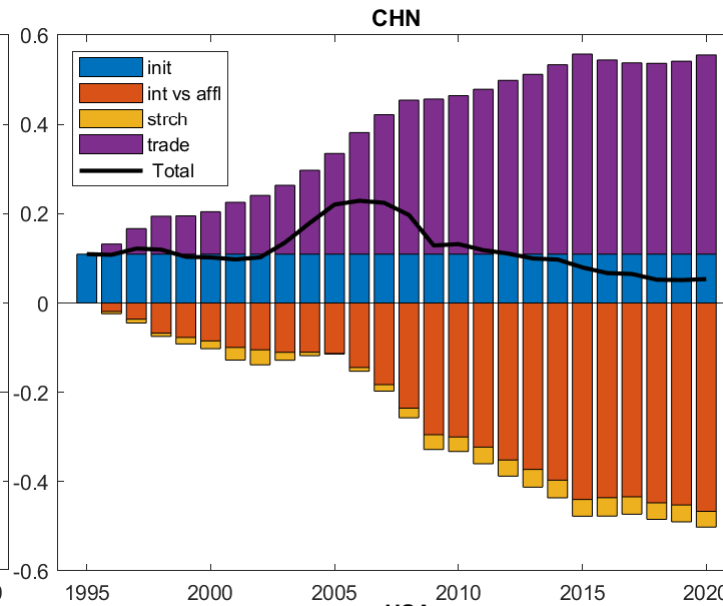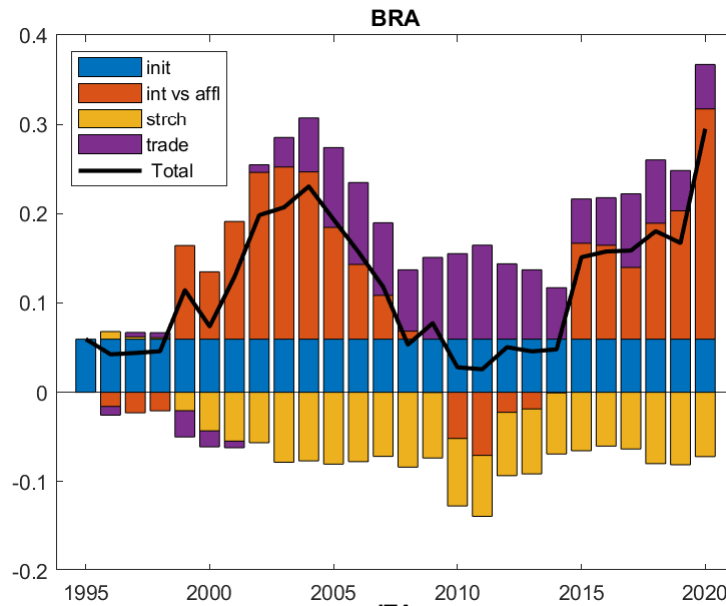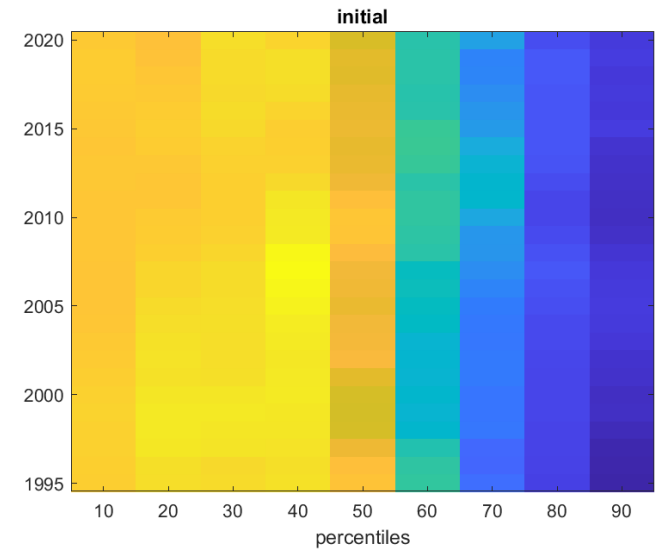
Emissions and development
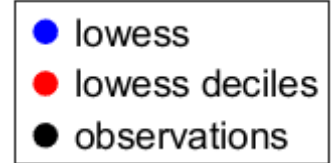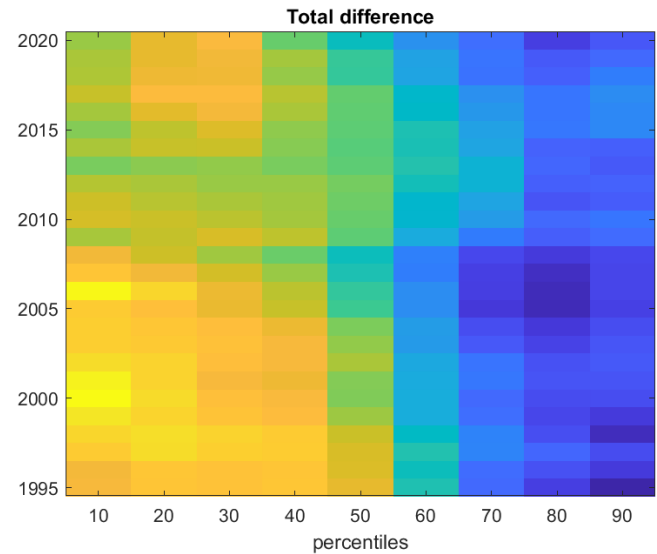

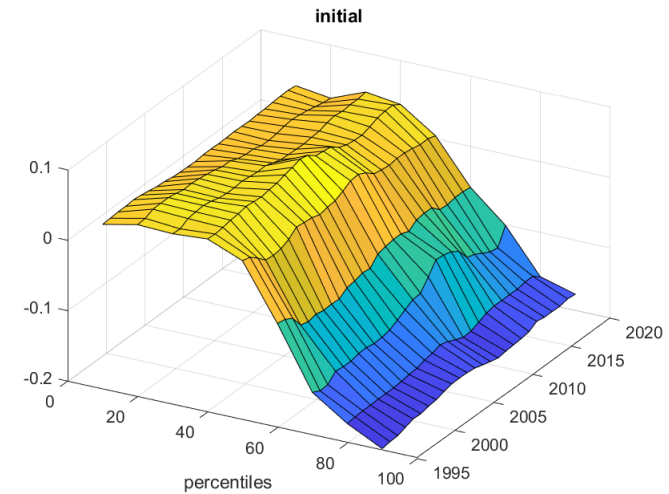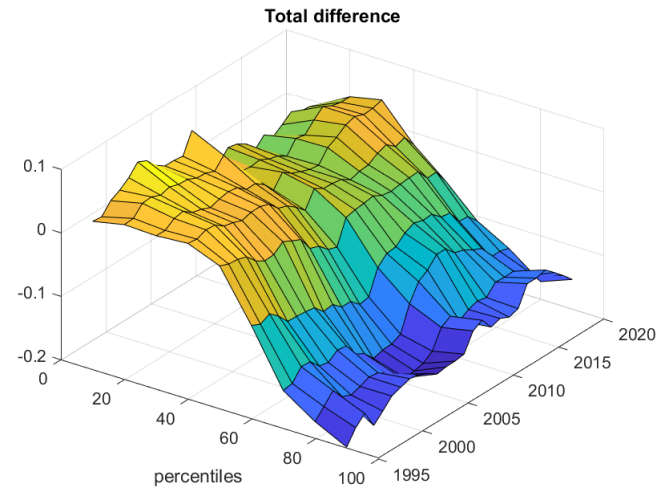- We use the lowess smoother to quantify the relation to log GDP pc; below is result for total difference
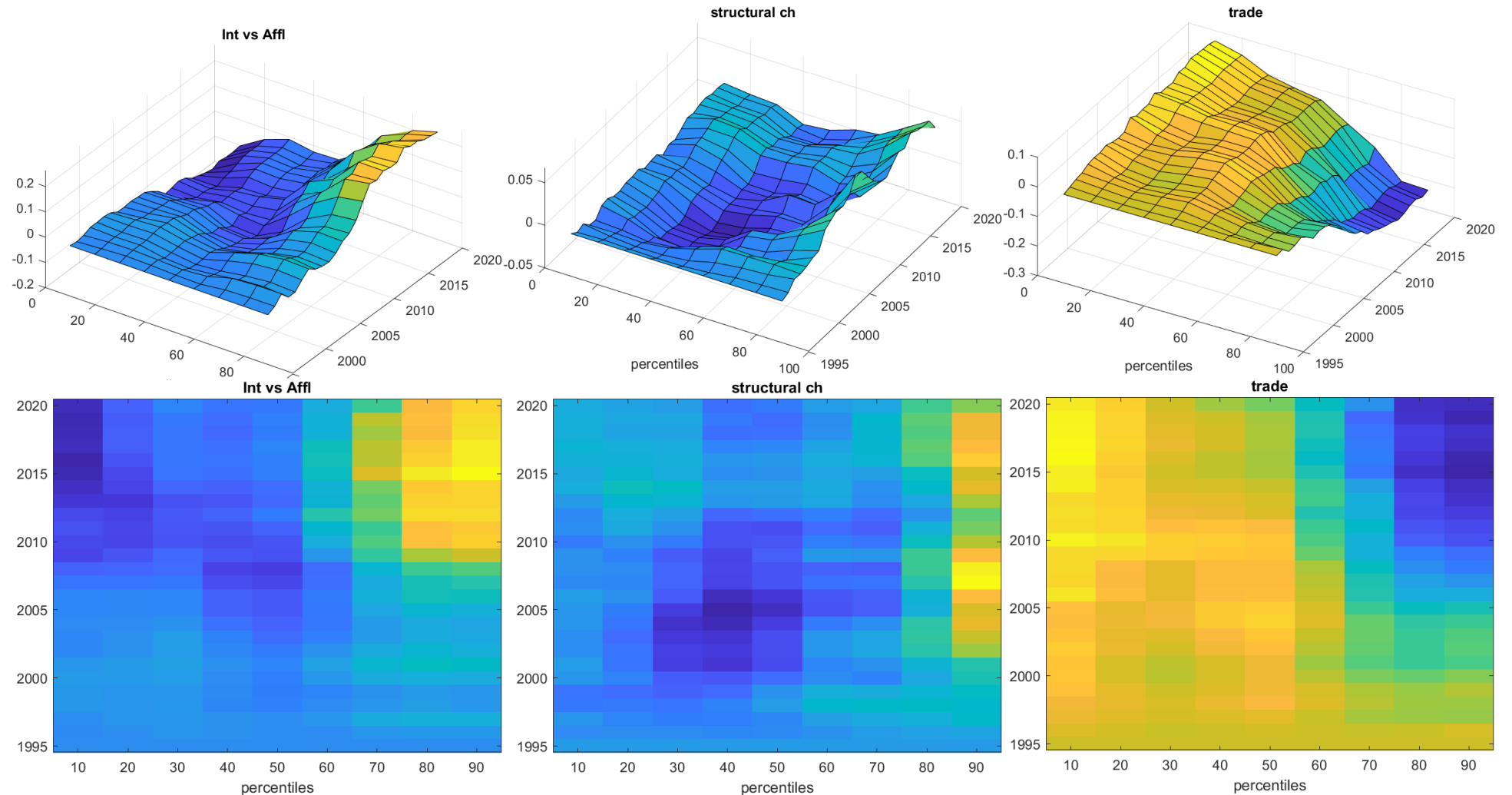

- We perform lowess for the 3 decomposition terms and the initial diff

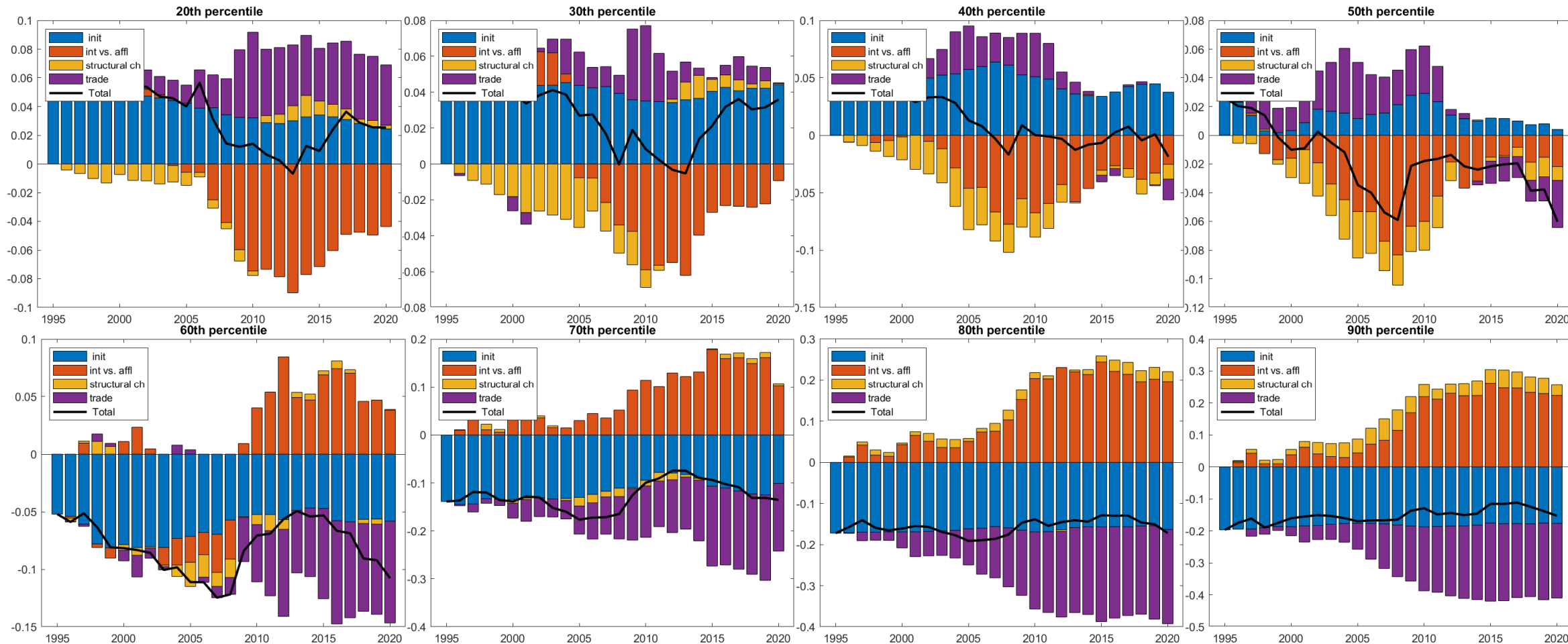# Summarizing the entire period (total and init)

Summarizing the entire period (3 effects)

Deciles on the time axis (lowess!)

For Intensity vs Affluence, the footprint side dominates at all deciles in the second half of the period

By way of conclusions…

- In the lower half of the development ladder, countries significantly reduced their net exports of embodied emissions, with two opposing effects:
  - Intensity vs. Affluence effect <u>decreases</u> net exported embodied emissions
    - Footprint side is usually positive (*own demand outweighs intensity reductions including own*) and territorial side either positive or mildly negative
  - Trade effect <u>increases</u> net exported embodied emissions
- An exception occurs from 2013 around 20-30th percentile where the Intensity vs. Affluence effect weakens and the trade effect increases territorial emissions relative to the footprint

By way of conclusions…

- In the upper half of the development ladder, net imports of embodied emissions remain the norm, but again there are two opposing effects
  - Intensity vs. Affluence decreases net imports of embodied emissions
    - Territorial side is negative but negative footprint side dominates (climate policy → *intensity reductions of suppliers including own outweigh increase in demand*)
  - Trade strengthens net imports of embodied emissions: relocation of "supply" to countries with higher emissions

An implication for policy

- Most of the policy debate is aimed at reducing emissions domestically (countries agree on targets to reduce their own emissions)

- But our results show that climate policies in developing countries can be justified as a responsibility of developed countries
  - Not only for historical reasons (developed countries are the early emitters), but also because of the role of contemporary GVCs in matching demand and supply for emissions