Université de Neuchâtel

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DECOMPOSING WORLD-WIDE SO_2 EMISSIONS 1990-2000

IS TRADE BAD FOR THE ENVIRONMENT?

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ISSUES

- Decrease in world-wide SO_2 emissions in the 90s
- Why?
  - more abatement activity, including in South
  - collapse of former Soviet Union
  - 1997 crisis in East Asia
- Opposite force:
  - scale effect
- Ambiguous force:
  - trade (pollution-haven effect vs. factor-endowment effect)?
- Lack of data $\Rightarrow$ difficult to:
  - disentangle those forces
  - estimate the role of trade

THIS PAPER

- **original combination of data on manufacturing**

  ⇒ **emission intensities at the country and sector level**

- **comprehensive decomposition of growth in emissions**

  ⇒ **scale, composition and technical effects**

- **construction of a simple no-trade benchmark**

  ⇒ **impact of trade on world emissions**

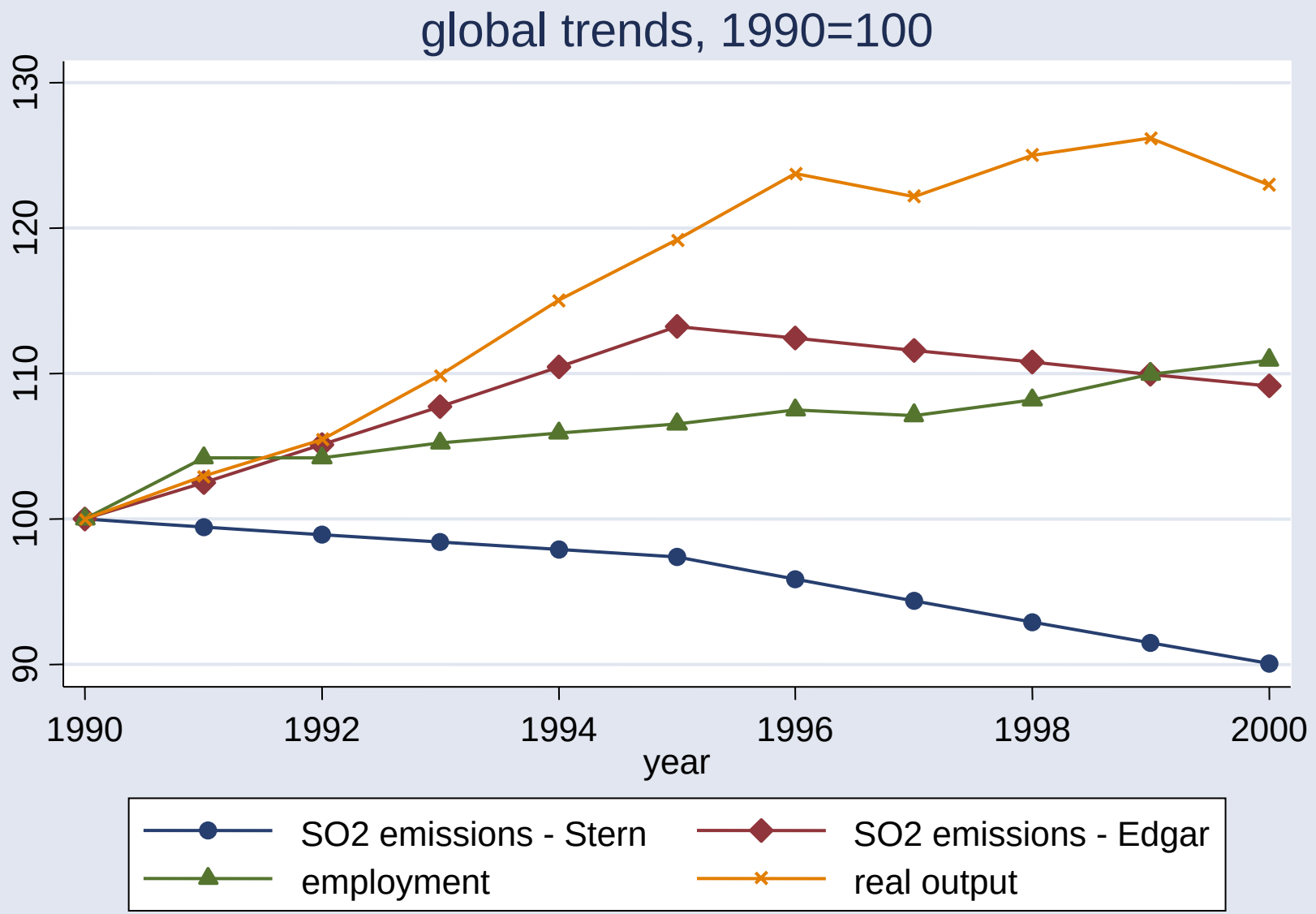
OUTLINE

I. STYLIZED FACTS

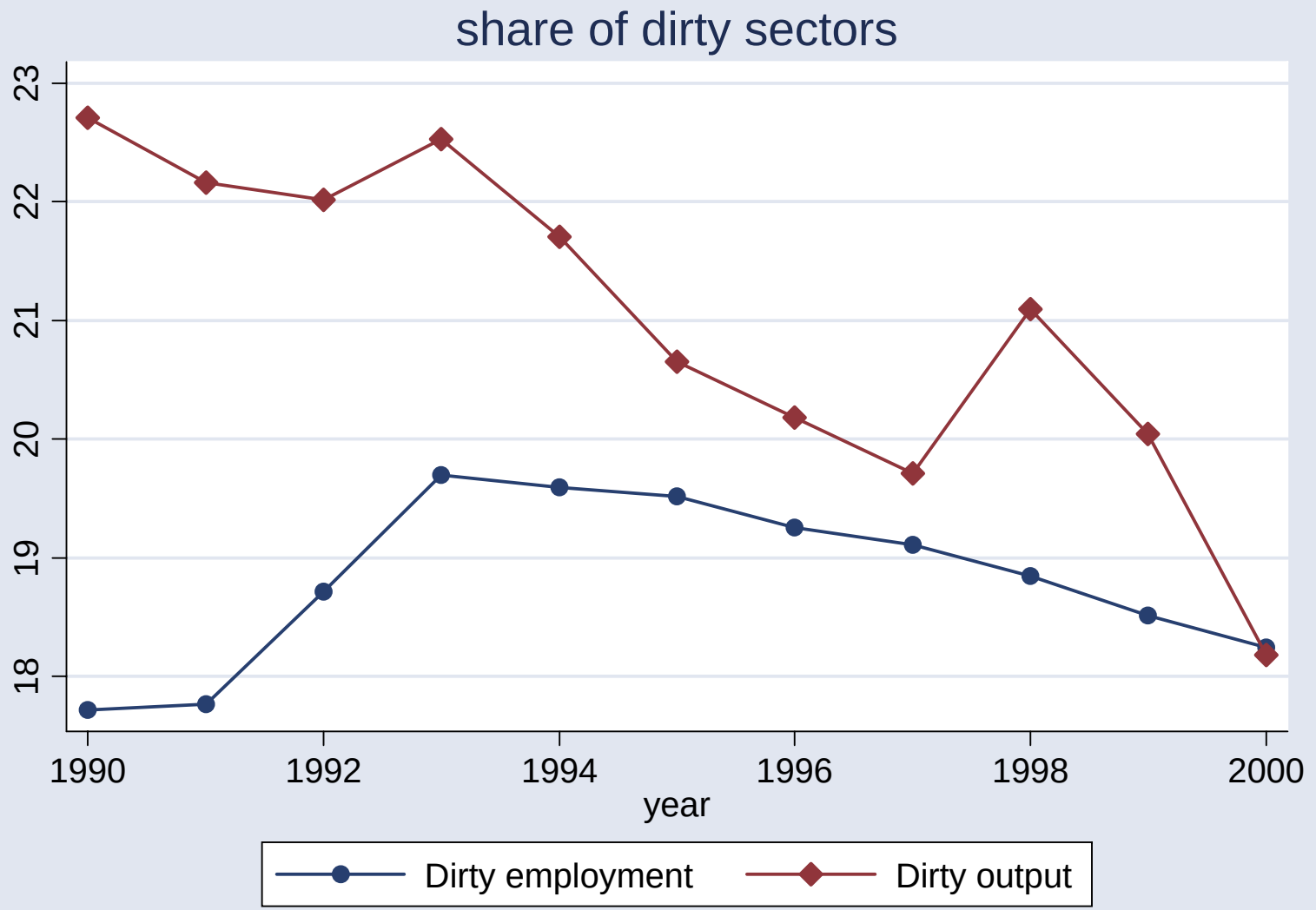
II. GROWTH DECOMPOSITION

III. IMPACT OF TRADE

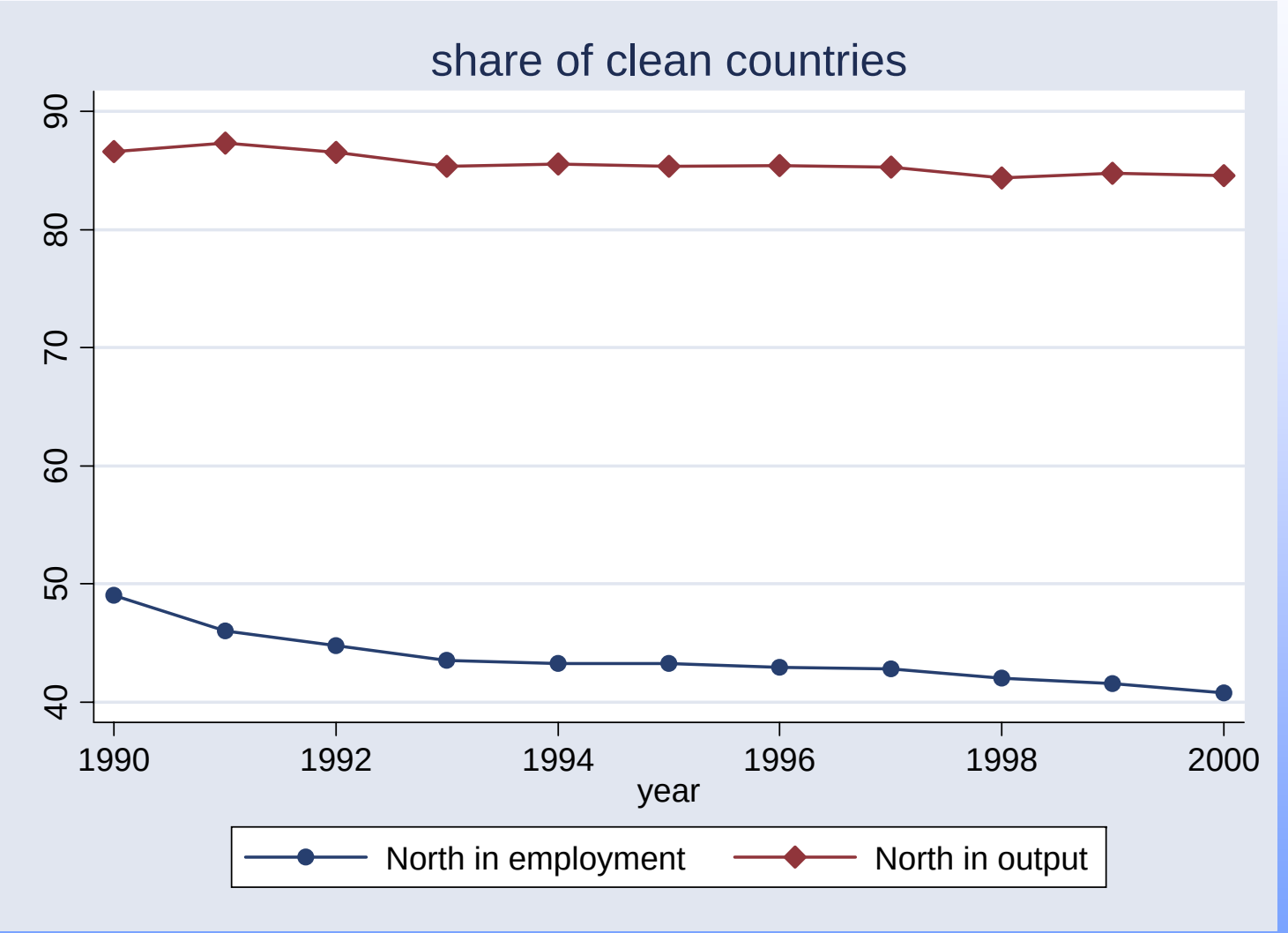
STYLIZED FACTS: (1) DECREASE IN EMISSIONS



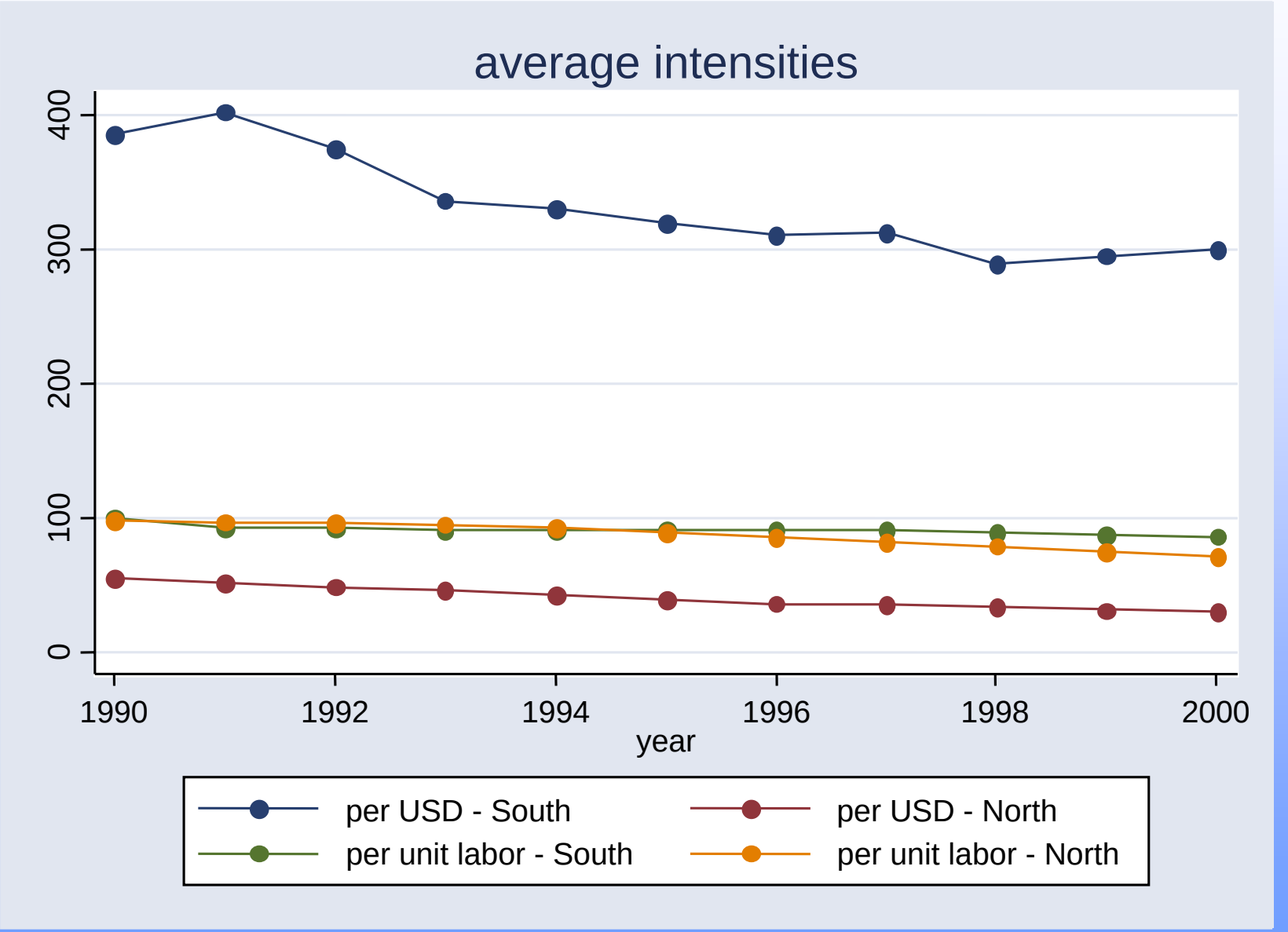
STYLIZED FACTS: (2) CLEANER PRODUCTS?



STYLIZED FACTS: (3) CLEANER COUNTRIES?



STYLIZED FACTS: (4) CLEANER TECHNOLOGIES?



STYLIZED FACTS: SUMMARY

- **emissions ↓ while employment and output ↑**
- **share of dirty products ↓ or →**
- **share of South in labor manufacturing ↑**
- **emission intensities ↓ world-wide**
- **emission intensities per unit labor are very similar between North and South**

⇒ orders of magnitude = ?...

GROWTH DECOMPOSITION FRAMEWORK

World emissions ($E_{..}$): $E_{..} = \Sigma_k \Sigma_i \gamma_{ki} L_{ki}$

(L: labor, γ : emission intensity)

Growth decomposition (^ means growth rate):

σ_i , σ_{ki} : **emissions shares**

φ_i , φ_{ki} : **labor shares**

$$\hat{E}_{..} = \ldots = \Sigma_i \sigma_i \hat{L}_{..} + \Sigma_i \sigma_i \hat{\varphi}_i + \Sigma_k \Sigma_i \sigma_{ki} \hat{\varphi}_{ki} + \Sigma_k \Sigma_i \sigma_{ki} \hat{\gamma}_{ki}$$

scale effect

between-country effect

between-sector effect

technical effect

DATA SOURCES

- **Sources**
  - **emission intensities at sector level : World Bank IPPS (Hettige et al, 1995), only valid for the US in 1987**
  - **emissions national level: Stern (2006) and Olivier& and Berdowski (2006 – Edgar)**
  - **trade, production, employment: World Bank, Trade & Production database, Nicita and Olarreaga (2006)**
- **Data sample**
  - **62 countries – 6 regions**
  - **28 ISIC 3digit sectors**
  - **3 years: 1990, 1995, 2000**

SIMILARITY OF INTENSITIES PER UNIT LABOR

- **Hettige et al (2000): panel of 11 countries: intensities per dollar vary widely but intensities per unit labor are roughly constant**
- **This paper: reconstruction of Chinese IPPS intensities and comparison with US ones: rank correlation larger than 0.9 for per unit labor intensities (between 0.7 and 0.9 for per dollar intensities)**
- **This paper: cf. North-South stylized facts above: average intensities per unit labor are very similar, large differences for per unit dollar values**

⇒ assume identical per unit labor intensities across regions and years, except for a conversion ratio that matches reported emissions with calculated ones

OBTENTION OF EMISSION INTENSITIES

i. aggregate 62 countries in 6 regions

ii. apply the (original IPPS) US per labor intensities and combine with labor to obtain total calculated emissions per year and region, CE_{it}

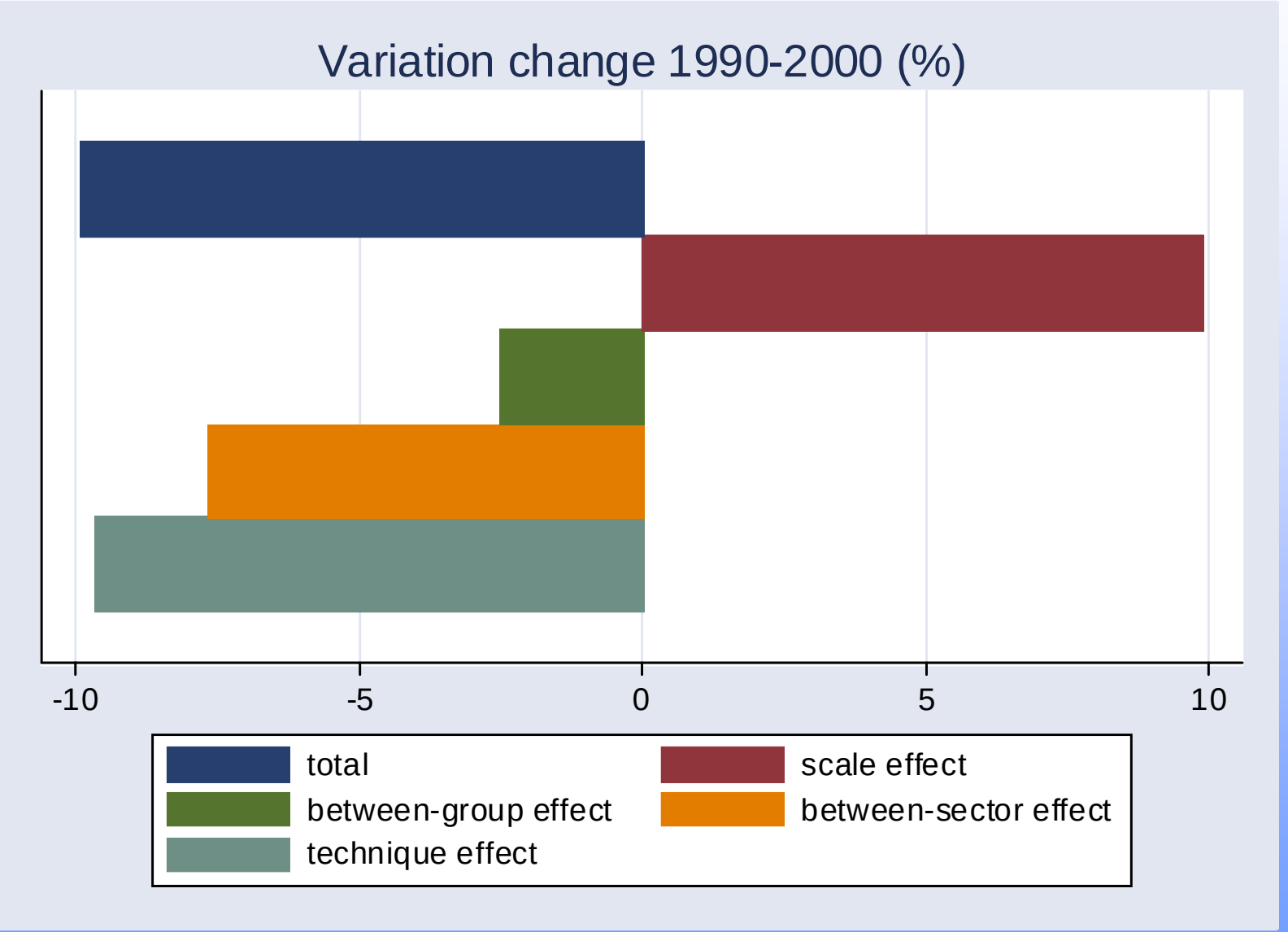
iii. use Stern data to obtain total effective emissions per year and region, EE_{it}

iv. calculate the conversion ratio, $R_{it}=EE_{it}/CE_{it}$

v. apply the conversion ratio to US IPPS intensities to obtain region and year specific intensities,

$\gamma_{kit}= \gamma_{k,US}* R_{it}$

GROWTH DECOMPOSITION: TOTALS



GROWTH DECOMPOSITION: BY REGION

	Total net effect (1)+(2) +(3)+(4)	Total gross effect |(1)|+|(2)| +|(3)|+|(4)|
World [a]	-9.91	
Share in total gross effect: [b]		
Asian High Income	-2.3	6
Europe	-21.7	28.5
North America	-4.2	10
Africa	-0.4	5.3
Asian Low Income	3	35
South America	7.4	15.3

GROWTH DECOMPOSITION: BY SECTOR

	Total net effect (1)+(2) +(3)+(4)	Total gross effect |(1)|+|(2)| +|(3)|+|(4)|
Share in total gross effect:[b]		
Food products	0.2	3.6
Beverages	0.5	1.5
Textiles	-0.6	1.2
Paper and products	-0.5	7.2
Industrial chemicals	-6.8	14
Other chemicals	-0.3	2.3
Petroleum refineries	-15.2	23.8
isc. petroleum and coal products	-2.4	4.1
ıer non-metallic mineral products	8.3	13.8
Iron and steel	-6.1	13.8
Non-ferrous metals	-0.7	9.7
Machinery electric	-0.6	1
Transport equipment	-0.2	0.5

GROWTH DECOMPOSITION: SUMMARY

- **scale effect: +1% a year**
- **technical effect: -1% a year**
- **composition effects: negative, combined: -1% a year**
- **strong compensating forces in Low Income Asia: becoming larger but also structurally cleaner**
- **petroleum refineries, industrial chemicals and iron&steel are loosing importance**

⇒ what about trade ?...

TRADE IMPACT: A SIMPLE FRAMEWORK

Key idea: trade allows for a redistribution of worldwide production (composition effect)

Assumption: consumption unchanged ⇒ autarky simply means producing all consumed products at home

⇒shift from autarky to trade means:

- **more emissions because of exports**
- **less emissions because of imports**

⇒at the disaggregated level the change in emissions is:

$$\Delta E_{ki} = g_{ki} (X_{ki} - M_{ki})$$

g_{ki}: per dollar intensity ($g_{ki} = \gamma_{ki} / \Pi_{ki}$ where Π_{ki} is labor productivity)

⇒ aggregation...

TRADE IMPACT: TWO SIMPLE FORMULAS

At the country level:

$$\Delta E_i = g_i^X X_i - g_i^M M_i \quad (1)$$

$g_i^X (g_i^M)$: average intensity in exports (imports)

Interpretation: trade leads to an increase in emissions if exports are dirtier than imports on average.

At the sector level ($M_k = X_k$, n: number of countries):

$$\Delta E_k = n M_k \mathrm{cov}(\eta_{ki}, g_{ki}) \quad (2)$$

η_{ki}: net export share of country i in world imports

Interpretation: trade leads to an increase in emissions if the largest net exporters are also the dirtiest producers (pollution-haven effect).

$\Rightarrow$ results...

TRADE IMPACT: BY REGION

1990	Changes in emissions with respect to autarky	
Region	Level	Share in autarky emissions (%)
High Income Asia	-74.64	-0.44
Europe	41.51	0.25
North America	41.01	0.24
Africa	92.72	0.55
Low Income Asia	-503.99	-2.99
South America	107.88	0.64
World	-295.51	-1.75
(World-2000	*-388.19*	*-2.52)*

TRADE IMPACT: BY SECTOR

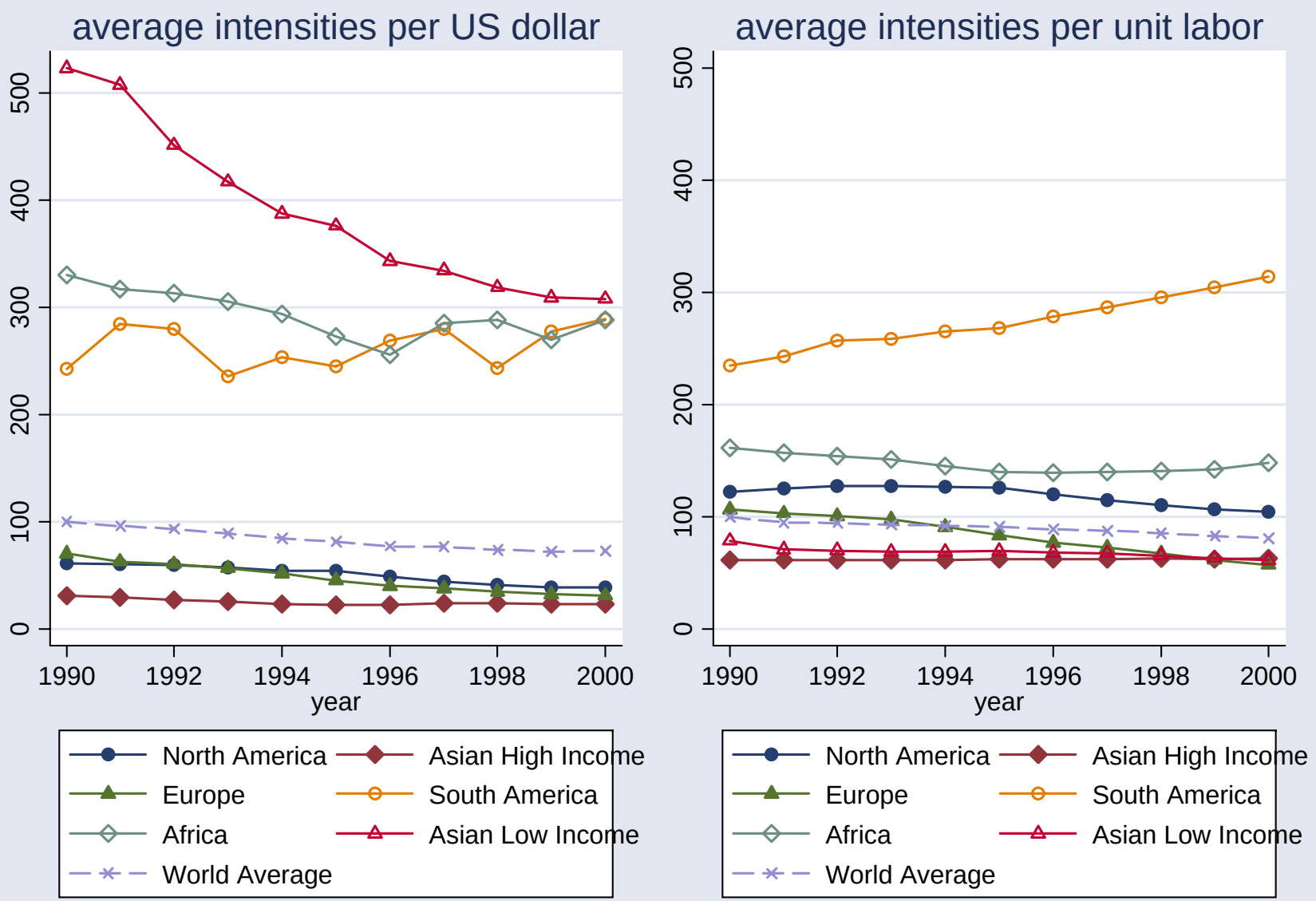
1990

Sector	Changes in emissions with respect to autarky: Level	Changes in emissions with respect to autarky: Share in autarky emissions (%)
Paper and products	-39.73	-0.24
Industrial chemicals	-264.48	-1.57
Petroleum refineries	46.79	0.28
Iron and steel	-78.32	-0.46
Non-ferrous metals	43.01	0.25
Machinery except electrical	-20.78	-0.12
...	...	...
Total	-295.50	-1.75
(Total-2000	*-388.20*	*-2.52)*

CONCLUSIONS AND LIMITATIONS

- **contribution of trade seems positive because:**
  - **the between-country effect is small and negative**
  - **rough estimates suggest that trade reduces emissions by roughly 2% with respect to a no-trade situation**
- **Limitations – further work**
  - **control for transport-embodied emissions**
  - **control for resource constraints in the simulations**

CLEANER TECHNOLOGIES?



GROWTH DECOMPOSITION – EDGAR DATA