



Energy Efficiency Analysis Using Index Decomposition for the Secondary and Tertiary Sector in Switzerland and Geneva

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Goals

Classic decomposition analysis

- Determining actual electricity energy intensity (correcting for structure effects)
- Determining sectoral contributions to economy-wide electricity intensity

Extras (this study)

- Effect of choice of activity indicator
- Comparing structure-corrected electricity intensity between regions
- Possibly: detecting economy-wide and sectoral effects of local energy efficiency programmes in Geneva?

Comparative index decomposition analysis

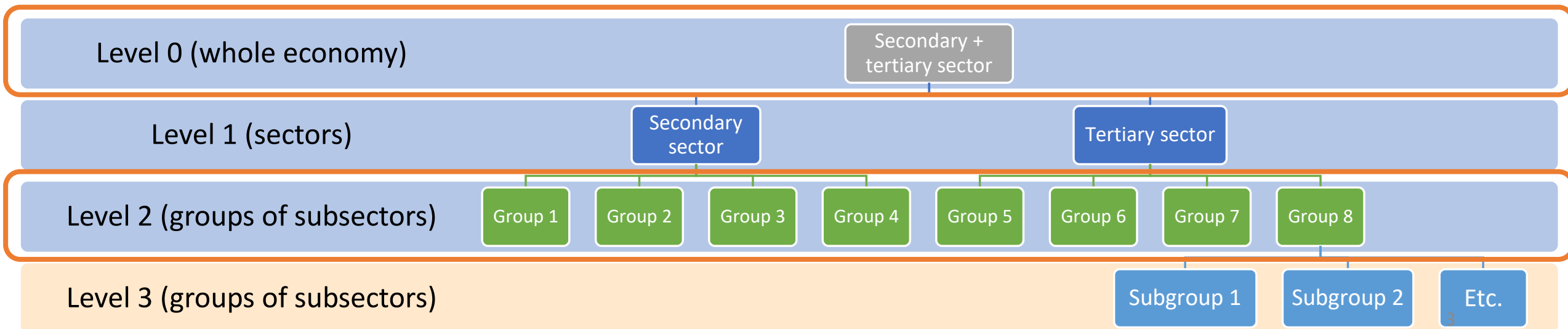
Essential:

Consistency required in

- Scope
- Data structures

Compare using:

- LMDI-I (logarithmic mean Divisia)
- Attribution analysis
- Multiple activity indices



Switzerland & Geneva: **electricity** saving targets

Switzerland

Reduction of per-capita electricity consumption by

- 3% from 2000 until 2020 and by
- 13% from 2000 until 2035.

	2000	2008
EC (TWh)	56	63
EC/cap (MWh)	7.8	8.2

Geneva

125 GWh of electricity savings between 2008 and 2015 (éco21)

	2000	2008
EC (TWh)	2.5	2.9
EC/cap (MWh)	5.9	6.3

Sources:

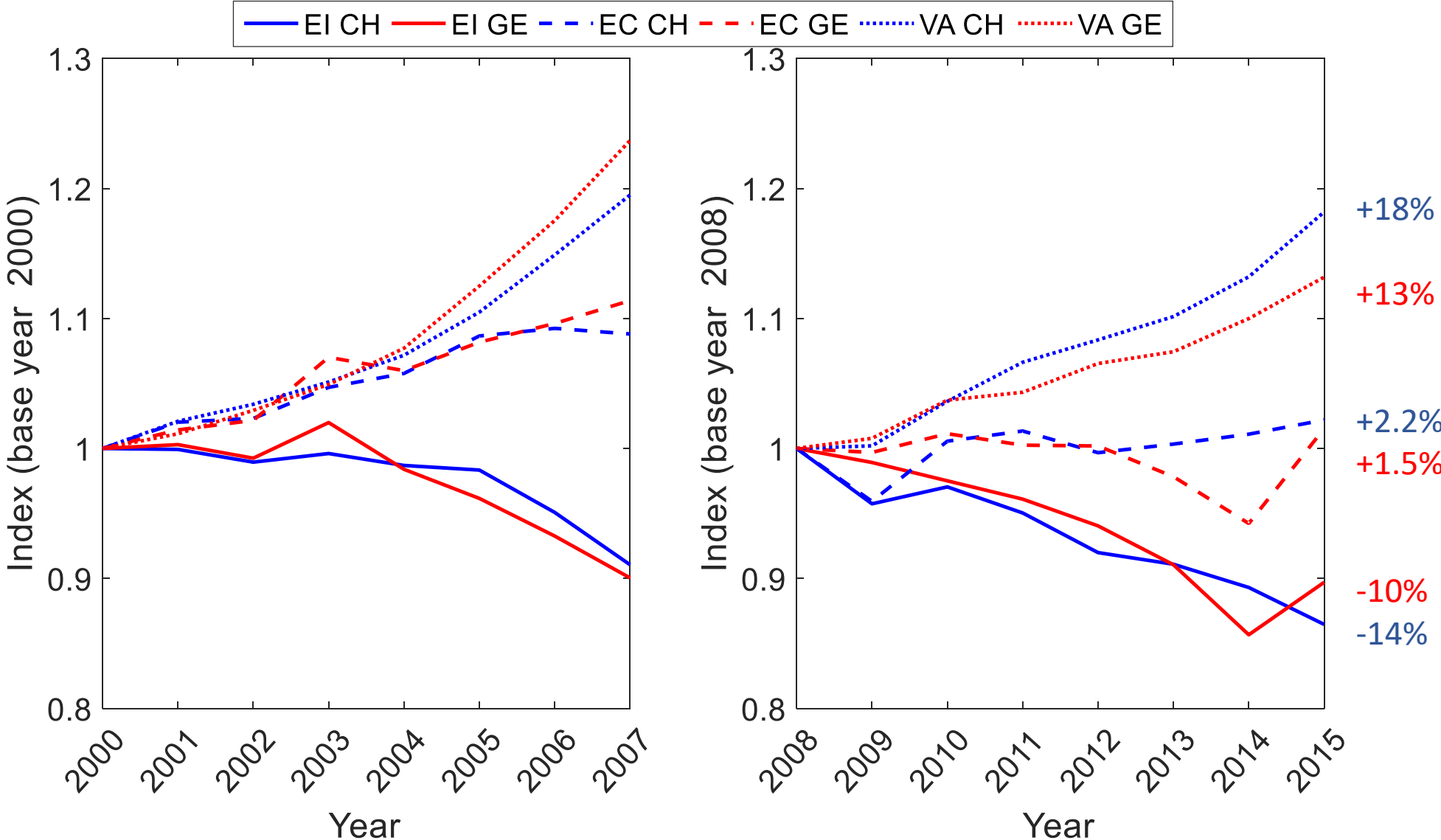
Office Cantonal de la Statistique (Geneva)

Federal Statistical Office (Switzerland)

EC: Electricity consumption

EC/cap: EC per capita

Switzerland – Geneva: Comparison of aggregate indices



EI: Electricity Intensity, EC: Electricity consumption, VA: Value added, CH: Switzerland, GE: Geneva

Method: Index decomposition analysis (LMDI-I) (1)

Multiplicative approach

$$\frac{E_T}{E_{t_0}} = D_{tot} = D_{act} D_{str} D_{int}$$

Activity effect

Structure effect

Intensity effect

Activity / output
(e.g. value added)

$$E_t = Y_t \sum_{i=1}^N S_{i,t} I_{i,t}$$

Structure: $S_{i,t} = \frac{Y_{i,t}}{Y_t}$

Intensity: $I_{i,t} = \frac{E_{i,t}}{Y_{i,t}}$

Method: Index decomposition analysis (LMDI-I) (2)

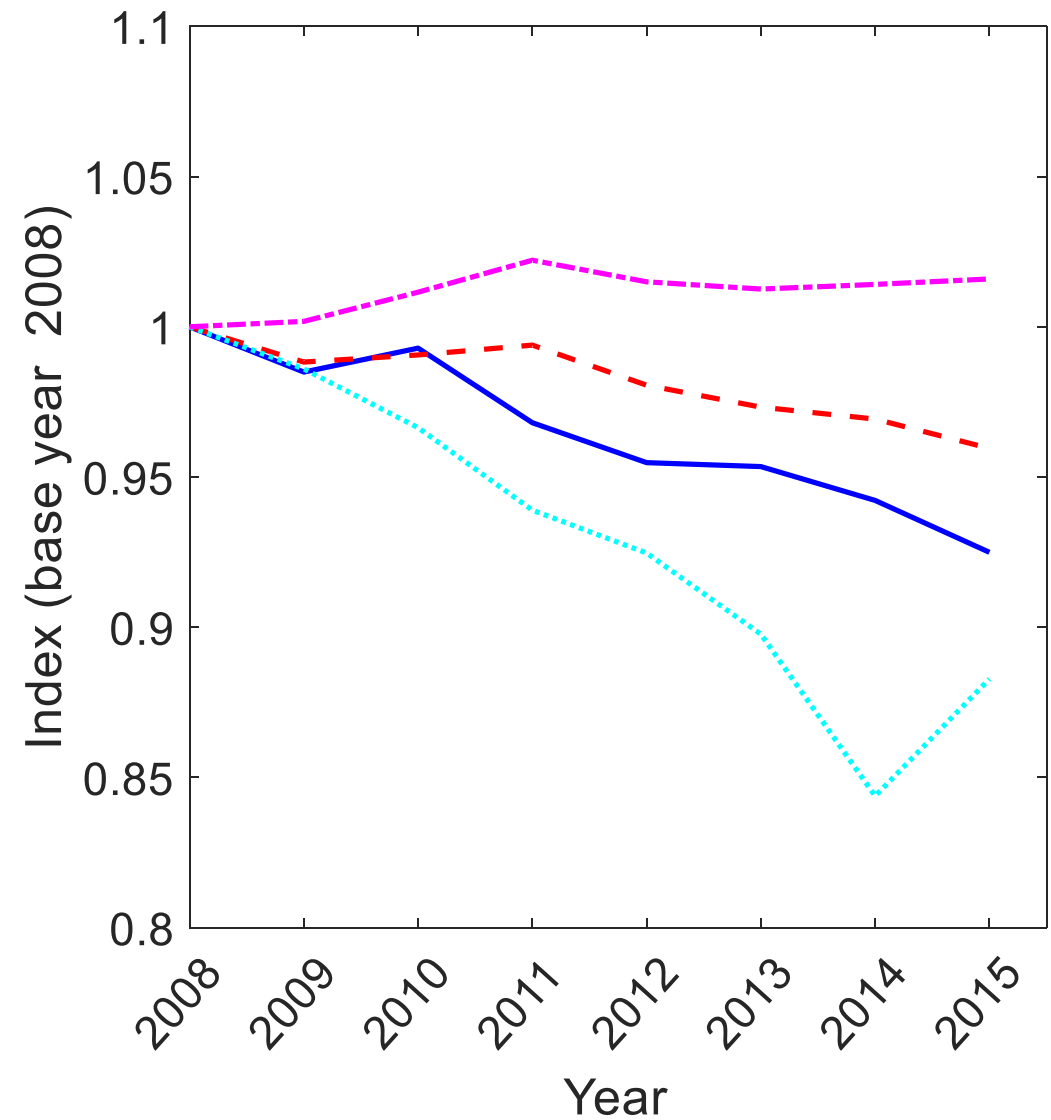
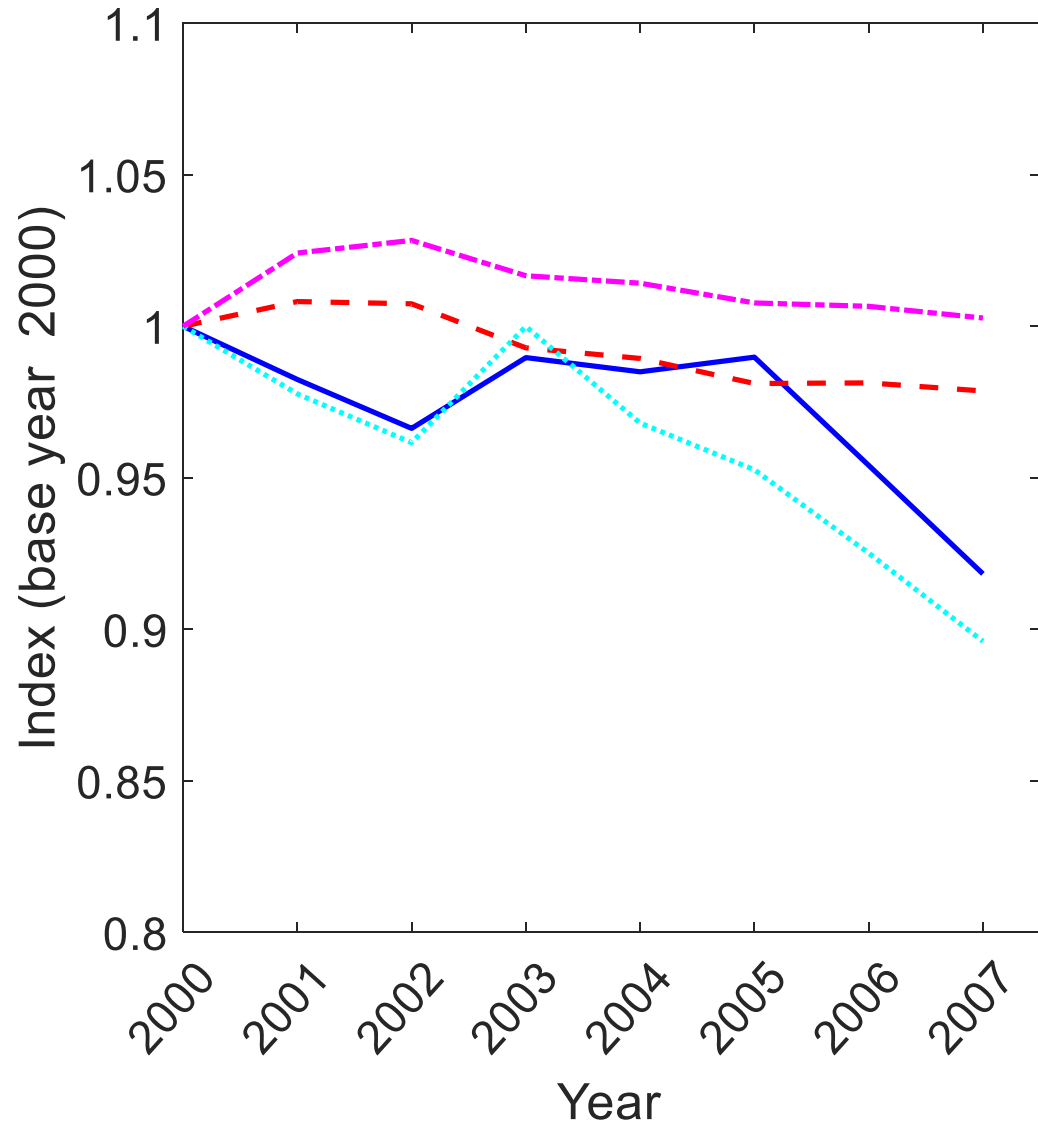
Multiplicative approach

$$D_{tot} = D_{act} D_{str} D_{int}$$

- $D_{act} = \exp \left\{ \sum_i w_{i,\tau} \ln \left(\frac{Y_T}{Y_{t_0}} \right) \right\}$
- $D_{str} = \exp \left\{ \sum_i w_{i,\tau} \ln \left(\frac{S_{i,T}}{S_{i,t_0}} \right) \right\}$
- $D_{int} = \exp \left\{ \sum_i w_{i,\tau} \ln \left(\frac{I_{i,T}}{I_{i,t_0}} \right) \right\}$

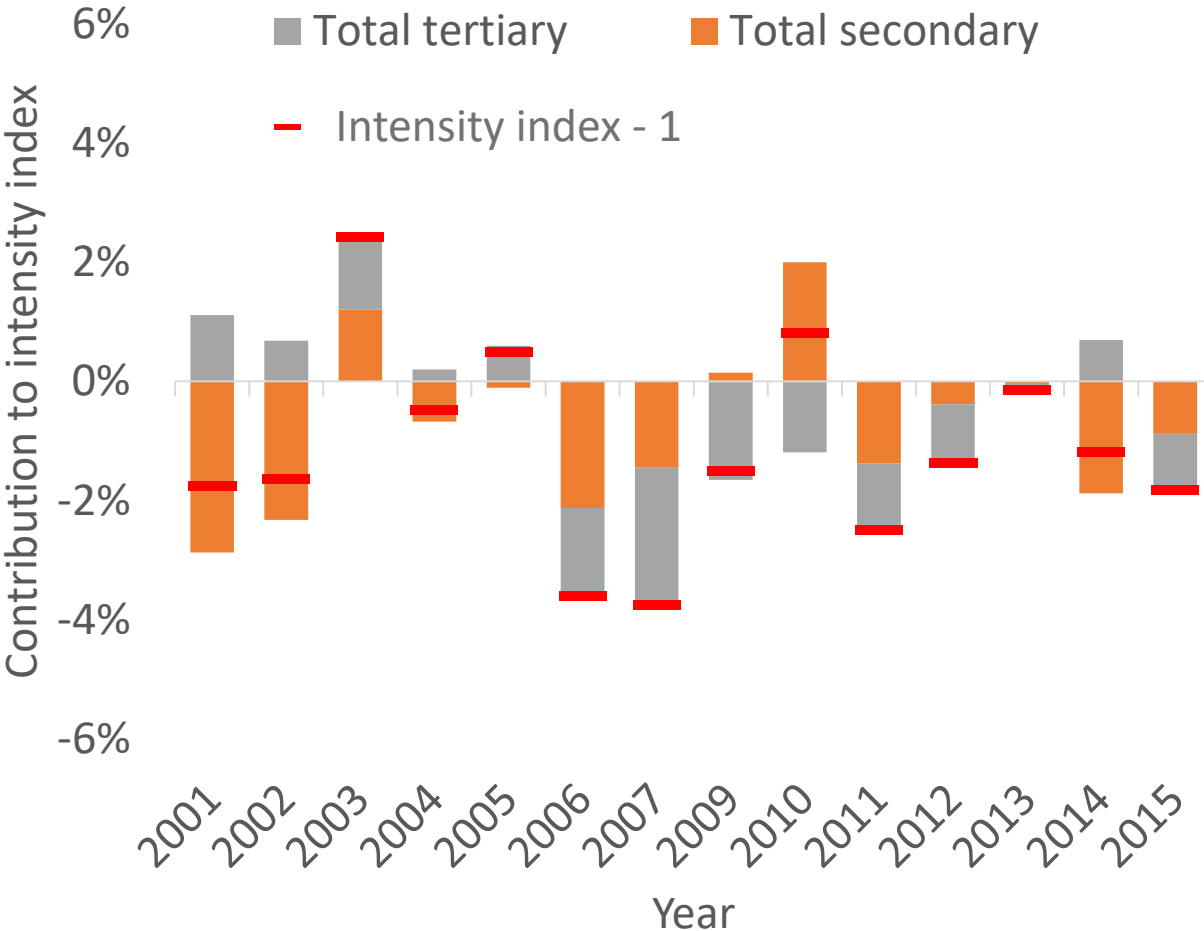
$$w_{i,\tau} = \frac{L(E_{i,0}, E_{i,T})}{L(E_0, E_T)}$$

Whole economy (secondary + tertiary sector)

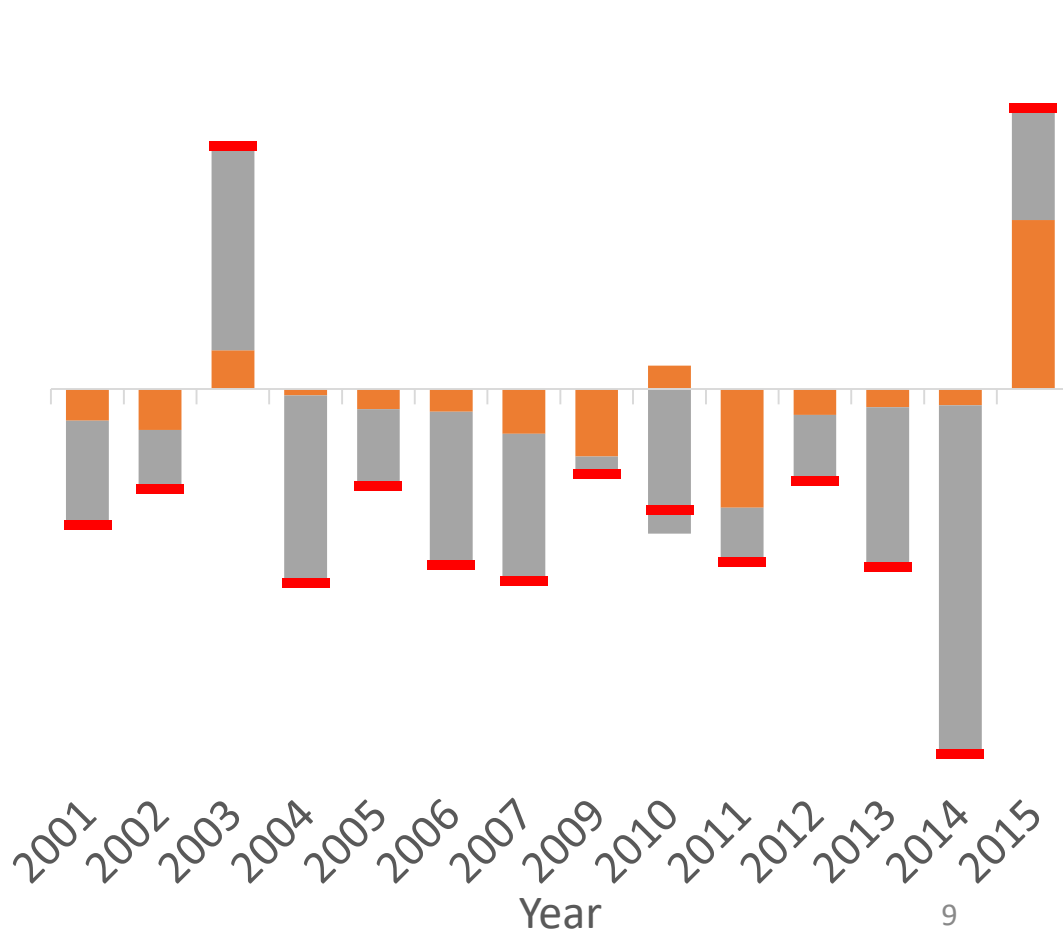


Contributions from secondary and tertiary sectors

Switzerland



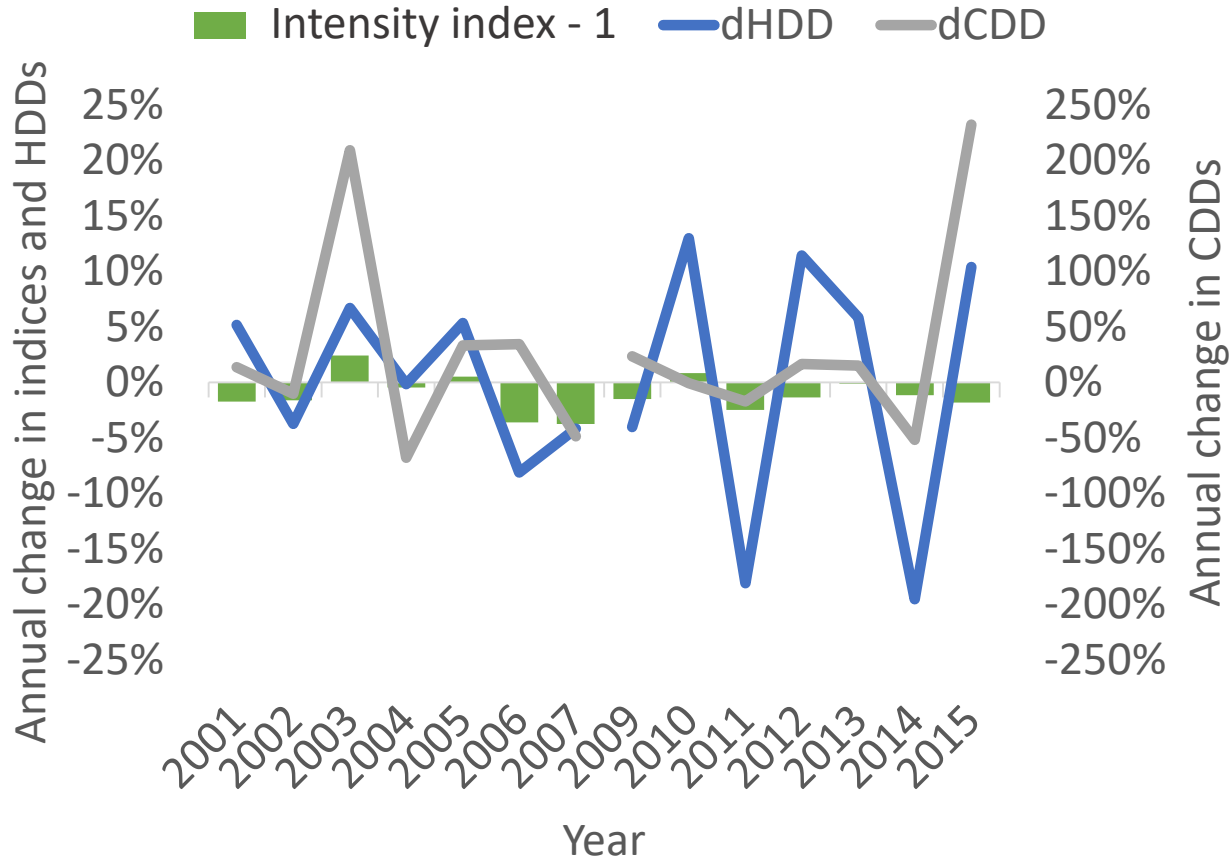
Geneva



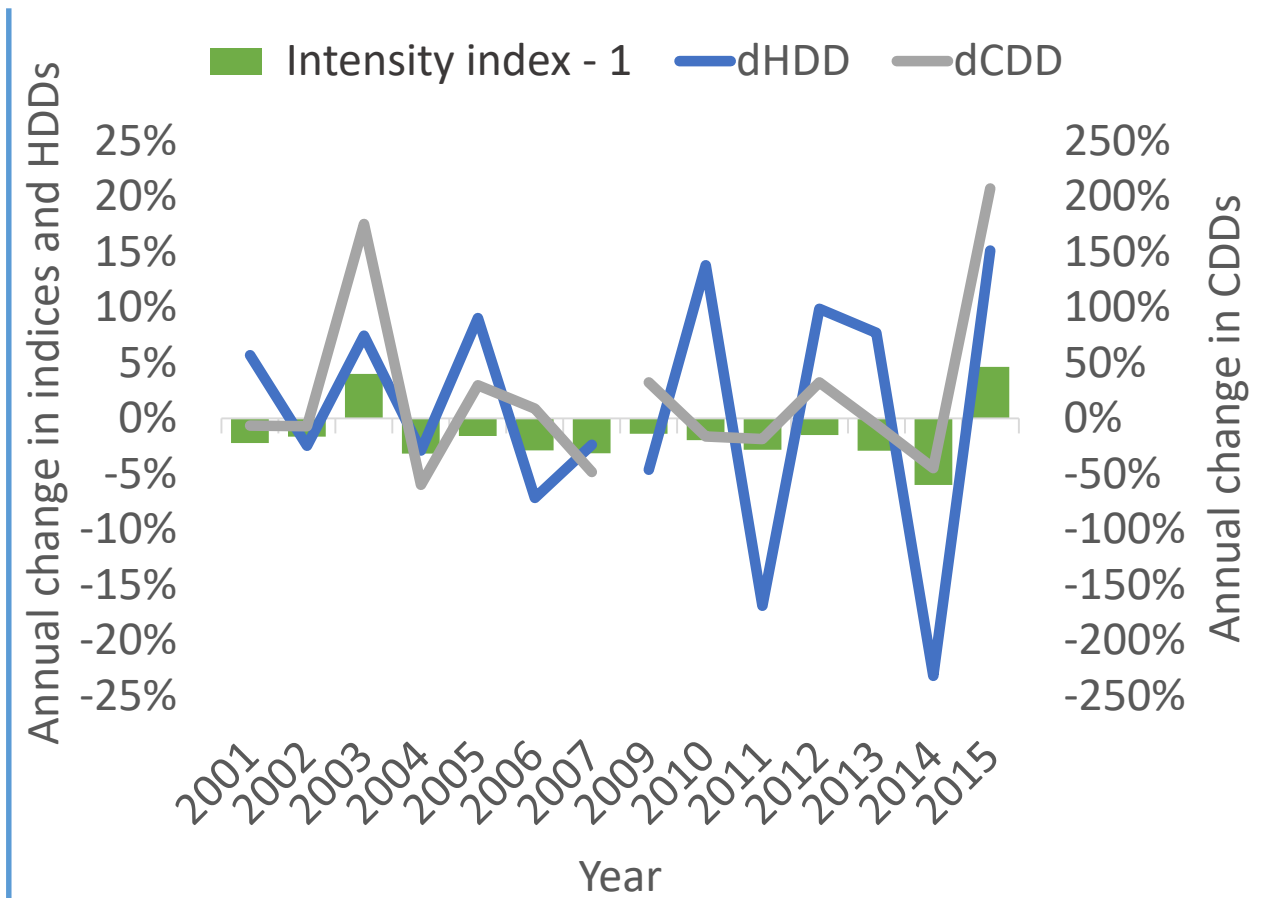
Weather effect

dHDD: Change in Heating Degree Days
dCDD: Change in Cooling Degree Days

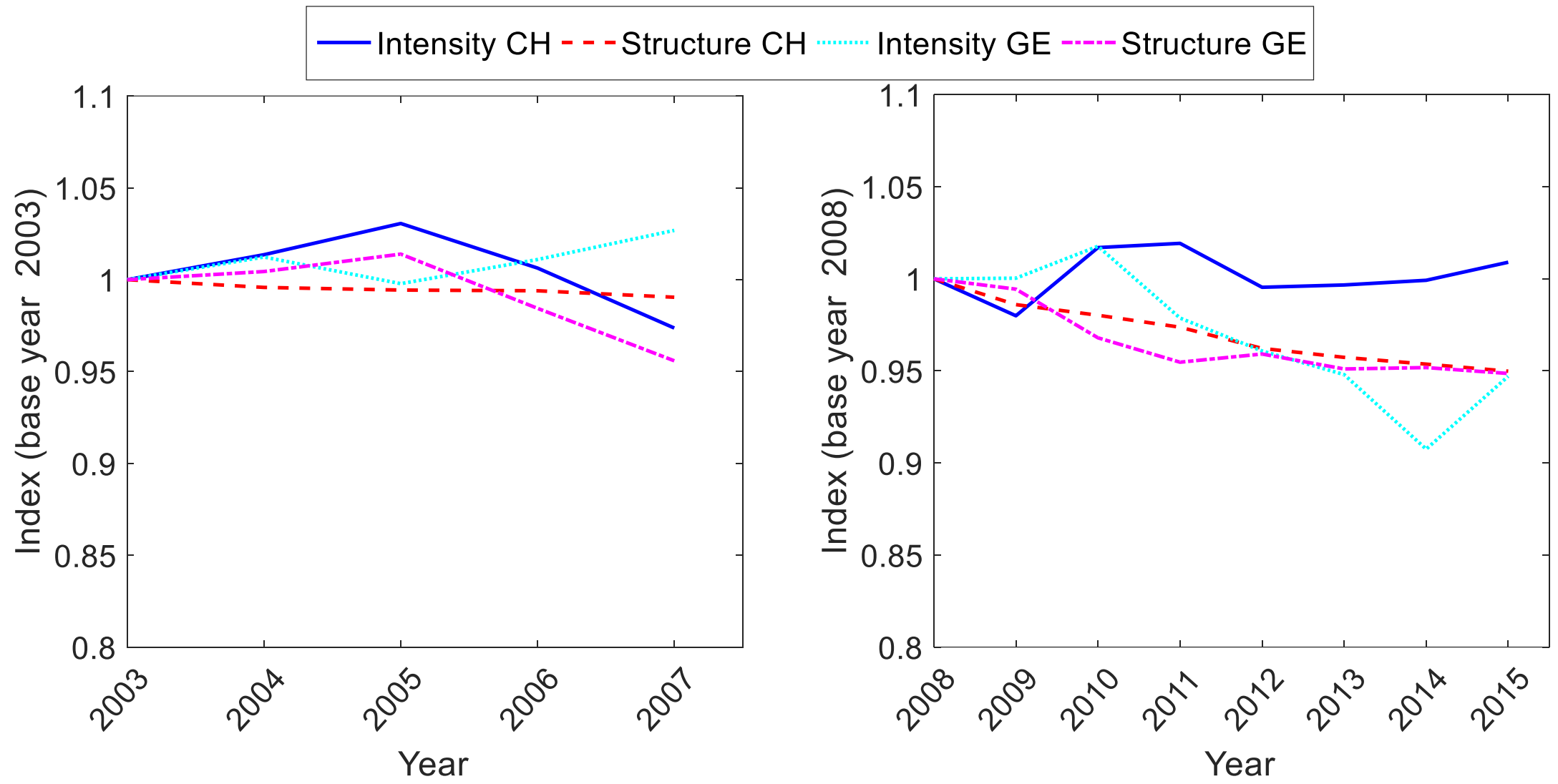
Switzerland



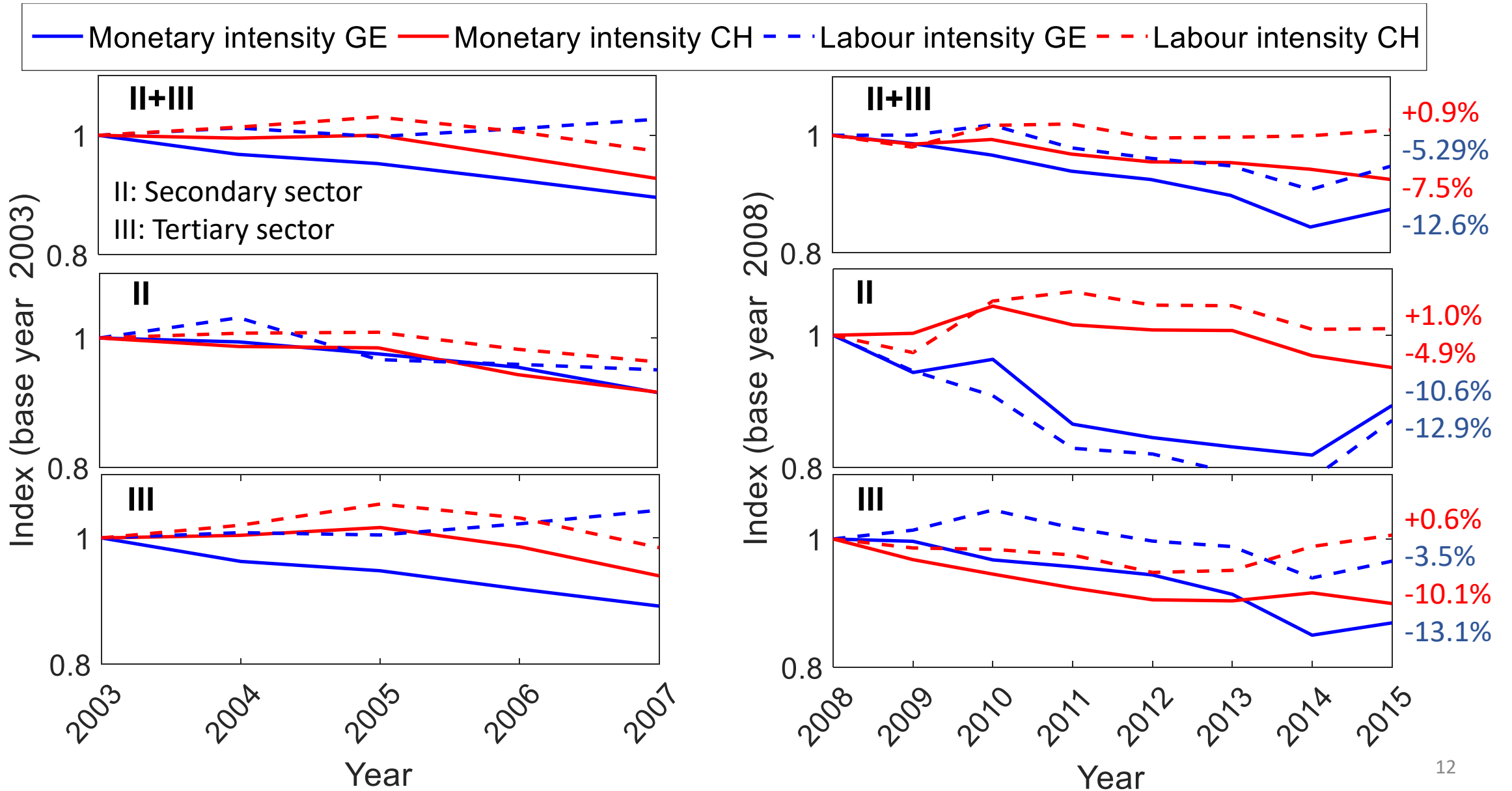
Geneva



Employment-based decomposition



Overview of electricity intensity indices



Productivity indicator: comparing value added & employment based results

Sector	Region	Period	Intensity		
			$D_{int}^{mon} - 1$	$D_{int}^{emp} - 1$	$D_{prod}^{emp} - 1$
II+III	GE	2003-2007	-10.4%	2.7%	14.6%
		2008-2015	-12.6%	-5.3%	8.4%
	CH	2003-2007	-7.2%	-2.6%	4.9%
		2008-2015	-7.5%	0.9%	9.1%
II	GE	2003-2007	-8.4%	-4.9%	3.8%
		2008-2015	-10.6%	-12.9%	-2.5%
	CH	2003-2007	-8.4%	-3.7%	5.1%
		2008-2015	-4.9%	1.0%	6.2%
III	GE	2003-2007	-10.8%	4.4%	17.0%
		2008-2015	-13.1%	-3.5%	11.1%
	CH	2003-2007	-6.0%	-1.5%	4.8%
		2008-2015	-10.1%	0.6%	11.9%

$$D_{int}^{mon} = \frac{D_{int}^{emp}}{D_{prod}^{emp}}$$

$$\frac{EC}{VA} = \frac{EC}{Emp} \frac{Emp}{VA}$$

Conclusions

- Correcting for structure revealed larger intensity trend deviations
- Swiss 2020 / 2035 targets: The electricity intensity improvement is...
 - ✓ In value added terms: good (EI decreased)
 - × In labour terms: not so good (EI stable)
- Detect effects of local EEPs? → Weather correction needed
- Comparison between activity indicators
 - Significant differences between monetary and labour-based intensity indices
 - Productivity and price effects
- Consistent multilevel framework → ensures comparability between regions and across sectors