Decomposition Analysis of Air Pollutants During the Transition and Post-Transition Periods in the Czech Republic

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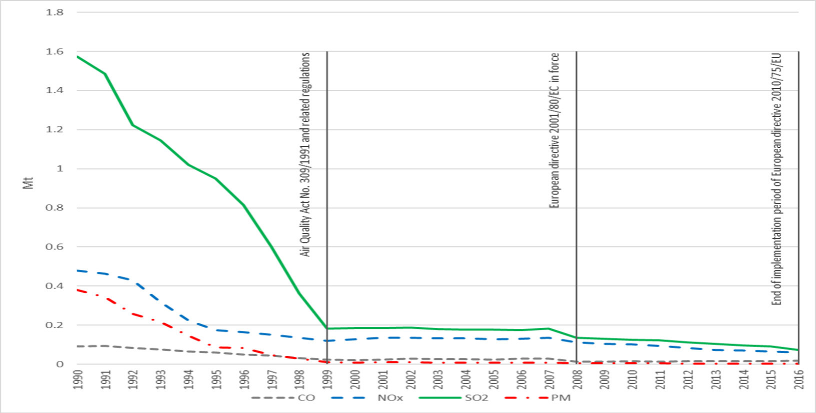
Agenda

Air pollutants emissions from large sources and regulation



Source: Own compilation based on CHMI REZZO database and Czech and European legislation

Channes of emission reduction at plant level

- reduction of output (scale)
- change of production technology - higher energy efficiency (energy intensity)
- change of fuel (fuel mix)
- end of pipe abatement technology (emission-fuel intensity)

Data

Emission and energy data

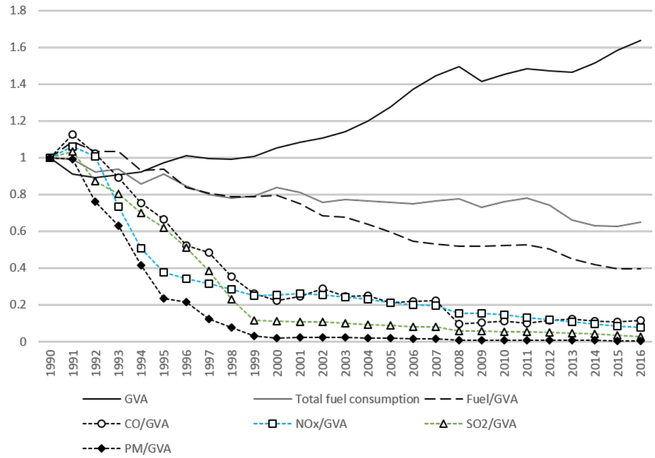
- from the Air Pollution Emission Source Register (REZZO)
- large stationary combustion processes - larger than 5 MWth
- till 2007 in NACE rev 1.1. and since 2008 in NACE rev.2

Activity data

- Gross Value Added (GVA) as a proxy for economic activity
- from 1990 to 1994, SUT reported only in the simple structure of a NACE rev.2 (38 sectors)
- since 1995 SUT reported in full level 2 NACE rev.2 classification (88 sectors)

- from 1990 to 2016 dataset aggregated to **26 sectors**
- from 1995 to 2016 dataset aggregated to **44 sectors**

Gross value added, total fuel consumption, fuel intensity and emissions per GVA, 1990–2016 (1990 level = 1.0)



Decomposition of change in emissions

$$\Delta E_{tot} = E^T - E^0 = \Delta E_{scale} + \Delta E_{str} + \Delta E_{int} \qquad (1)$$

3 factors	**4 factors**	**5 factors**
scale	scale	scale
structure	structure	structure
	fuel-intensity	fuel-intensity
emission intensity		fuel-mix
	emission-fuel intensity	emission-fuel intensity

$$\Delta E_{tot} = \Delta E_{scale} + \Delta E_{str} + \Delta E_{int} + \Delta E_{mix} + \Delta E_{emfi} \qquad (2)$$

The additive LMDI formulae for five-factor emission decomposing between year 0 and T

$$\Delta E_{scale} = \sum_{i,j} L(E_{i,j}^T, E_{i,j}^0) ln(Q^T / Q^0), \quad (3)$$

$$\Delta E_{str} = \sum_{i,j} L(E_{i,j}^T, E_{i,j}^0) ln(S_i^T / S_i^0), \quad (4)$$

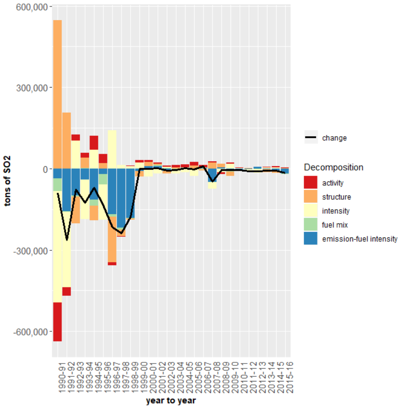
$$\Delta E_{int} = \sum_{i,j} L(E_{i,j}^T, E_{i,j}^0) ln(I_i^T / I_i^0), \quad (5)$$

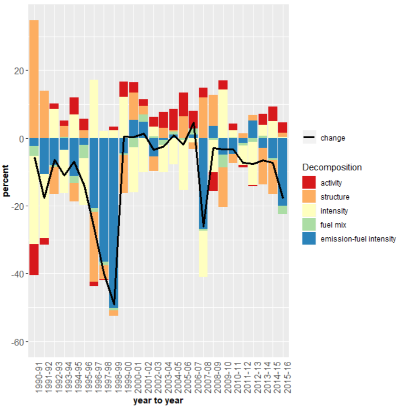
$$\Delta E_{mix} = \sum_{i,j} L(E_{i,j}^T, E_{i,j}^0) ln(M_{i,j}^T / M_{i,j}^0), \quad (6)$$

$$\Delta E_{emfi} = \sum_{i,j} L(E_{i,j}^T, E_{i,j}^0) ln(U_{i,j}^T / U_{i,j}^0), \quad (7)$$

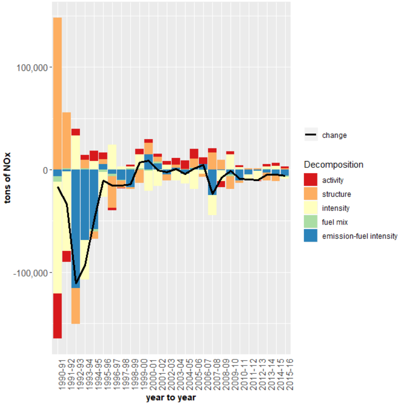
where $L(E_{i,j}^T, E_{i,j}^0) = (E_{i,j}^T - E_{i,j}^0)/lnE_{i,j}^T - lnE_{i,j}^0$, $Q = \sum_i Q_i$, $S_i = \sum_i Q_i/Q$, $I_i = \sum_i F_i/Q_i$, $M_{i,j} = \sum_{i,j} F_{i,j}/F_i$ and

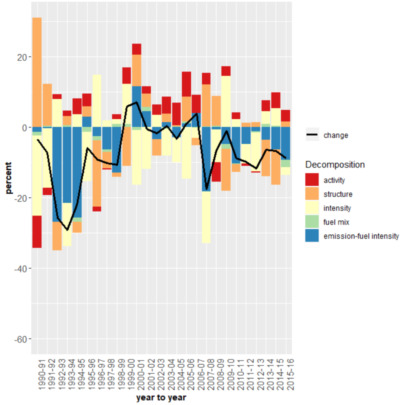
5 factor decomposition of SO2 emissions from 1990 to 2016



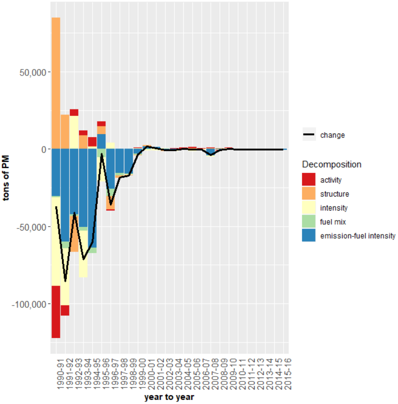


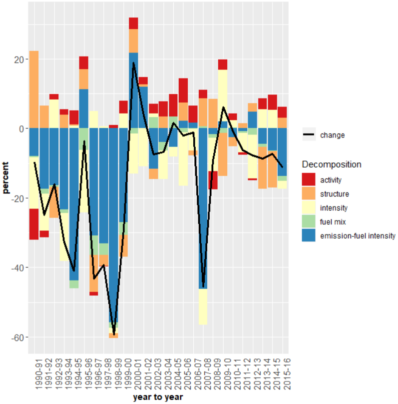
5 factor decomposition of NOx emissions from 1990 to 2016



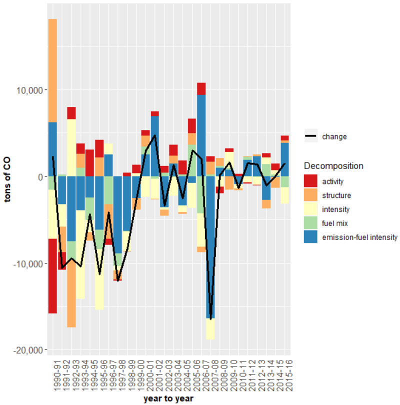


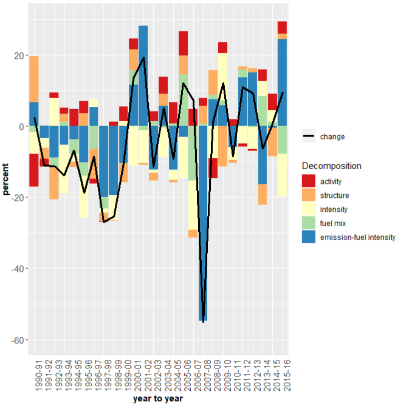
5 factor decomposition of PM emissions from 1990 to 2016



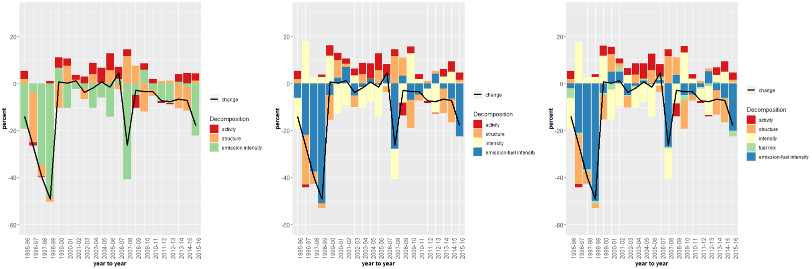


5 factor decomposition of CO emissions from 1990 to 2016

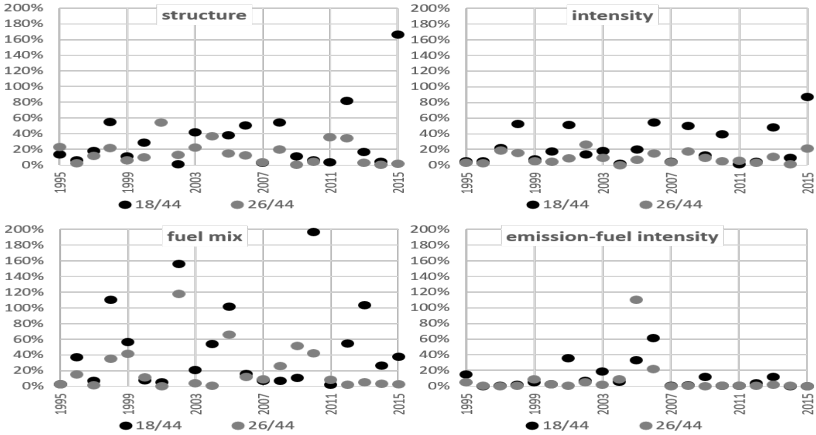




SA of LMDI decomposition with respect to the number of decomposition factors



Relative difference in LMDI effects btw 18 and 26 sectors relative to the effect value based on LMDI with 44 sectors



Conclusion

- 1990 to 1999 - emissions decreased cumulatively by at least 74 % - a negative **emission-fuel intensity effect** key driver of emissions reductions. **Fuel intensity effect** contributed most to reduction of SO2, NOx and PM emissions in the first 3 years after the Velvet Revolution.
- Adding a fuel specific dimension – in the 5-factor LMDI – affects not only the last factor, but all other LMDI effects. In our case, the scale effect is reduced by up to 1.3 %, the structure effect by up to 3.1 % and the fuel intensity in the 4-factor decomposition is reduced by up to 18.4 %.
- Relative differences in absolute values of LMDI effects between the breakdown to 44 and 26 sectors are on average 0.1, 15.7, 9.1, 21.7 and 8.1 % for the scale, structure, intensity, fuel mix and emission-fuel intensity effects, respectively.
- $\Longrightarrow$ apply as detailed a sector disaggregation as possible.

Acknowledgements

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