Bigger Cakes with Less Ingredients?

A Comparison of Material Use of the World Economy

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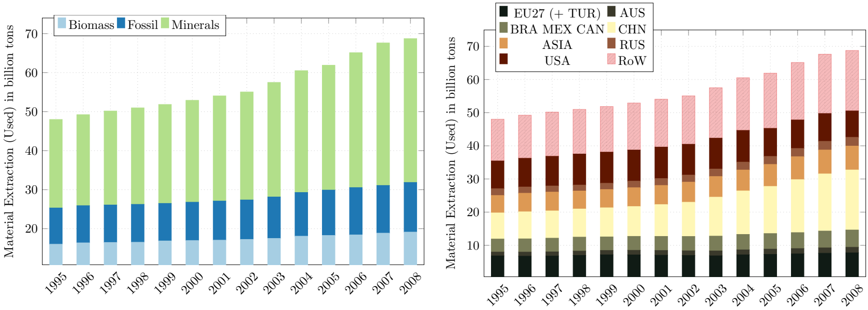
Introduction



(a) Global Extraction (b) Regional Distribution

Figure 1: Resource extraction and its regional distribution. Data: Dietzenbacher et al. (2013)

Motivation

- Severe environmental damages from extracting and processing materials (for metals, see Dudka and Adriano, 1997)
- Macro proxy for human impact on the environment
- Resource efficiency among flagship initiatives in Europe 2020 strategy
- *What drives material use on macro level?*
- Material Use: *Amount of materials employed directly by sectors and final consumers, both domestic and imported.*
- First Index Decomposition Analysis (IDA) of a panel of countries, only one other panel data study (Steger and Bleischwitz, 2011)

- World Input-Output Database (WIOD)
- Harmonized IO-Tables, 40 countries & 35 sectors
- Material extraction available (from SERI (2013) and Eurostat)
- Sectoral price deflators available
- Time span: 1995-2009
- Material extraction to material use: One price per (extractive) sector

Logarithmic Mean Divisia Index Decomposition

Country *j*'s material use driven by: Gross output $GO_{j,t}$ (activity effect), Industry structure $S_{i,j,t}$ (structural effect), and sectoral material intensity $MI_{i,j,t}$ (intensity effect)

$$M_{j,t} = \sum_i GO_{j,t} \frac{GO_{i,j,t}}{GO_{j,t}} \frac{M_{i,j,t}}{GO_{i,j,t}} = \sum_i GO_{j,t} S_{i,j,t} MI_{i,j,t}$$

Multiplicative decomposition

$$D_{Tot,j,t+1} = \frac{M_{j,t+1}}{M_{j,t}} = D_{Act,j,t+1} D_{Str,j,t+1} D_{Int,j,t+1}$$

Global Results

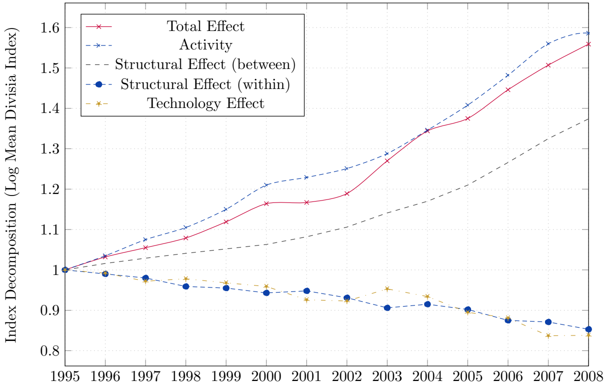


Figure 2: LMDI decomposition of global material intensity

Identifying Country Groups

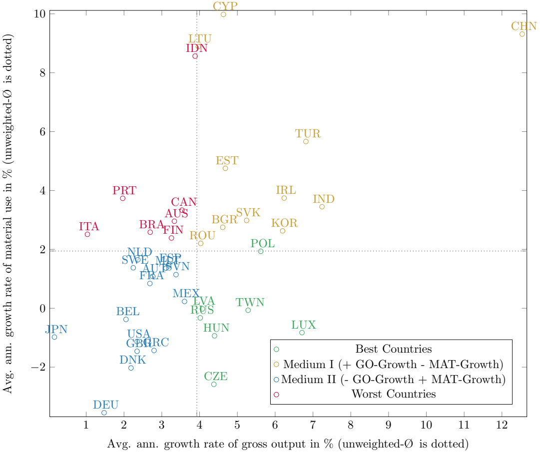


Figure 3: Gross output and material use growth

Best Performers Example: Russia

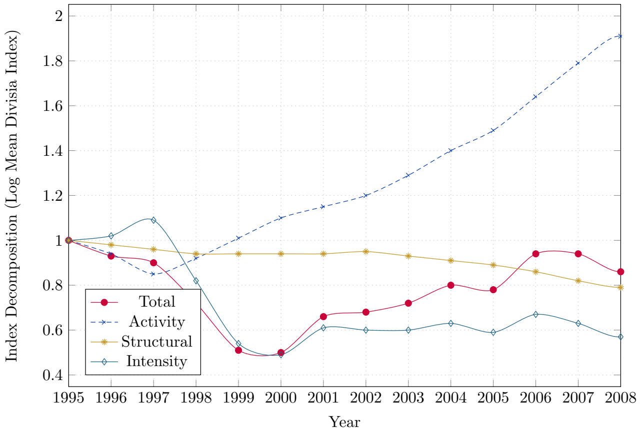


Figure 4: LMDI decomposition of material intensity (Russia)

Medium I Example: China

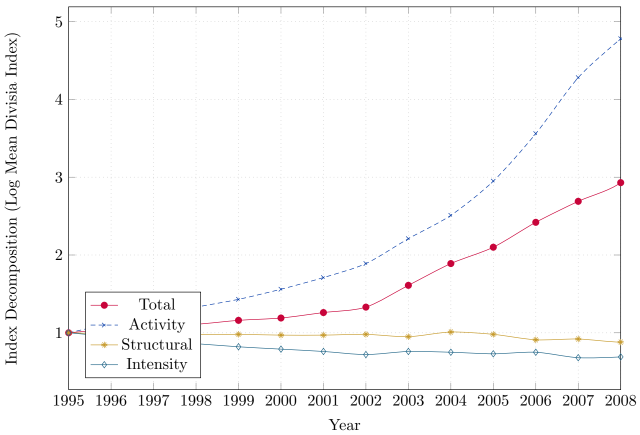


Figure 5: LMDI decomposition of material intensity (China)

Medium II Example: USA

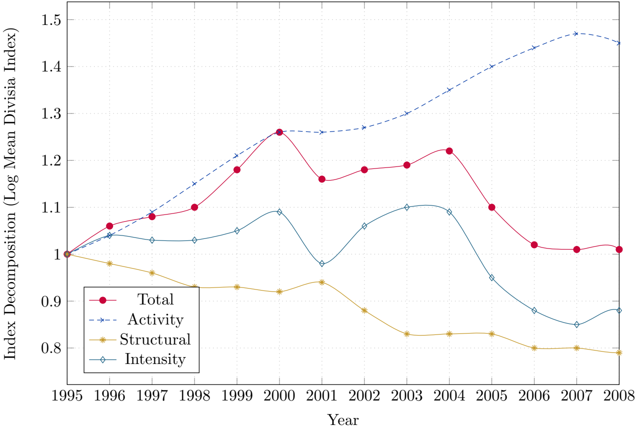


Figure 6: LMDI decomposition of material intensity (USA)

Worst Countries Example: Canada

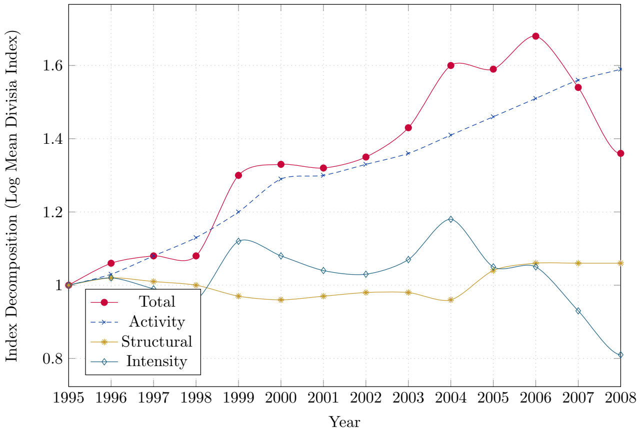


Figure 7: LMDI decomposition of material intensity (Canada)

Conclusions

- No dematerialization or decoupling
- Most important driver: economic growth
- Shift of production in more material intensive countries
- Structural change & efficiency gains counteract
- Further research
  - Econometric study of efficiencies
  - Decomposition of consumption based indicator
  - More structural modeling

Backup

Logarithmic Mean Divisia Index Decomposition

Decomposition formula

$$D_{k,j,t+1} = \exp\left(\sum_i \frac{L(M_{i,j,t+1}, M_{i,j,t})}{L(M_{j,t+1}, M_{j,t})} \ln\left(\frac{x^k_{i,j,t+1}}{x^k_{i,j,t}}\right)\right),$$

$$k \in \{Act, Str, Int\},$$

$$x^{Act}_{i,j,t} = GO_{j,t},$$

$$x^{Str}_{i,j,t} = S_{i,j,t},$$

$$x^{Int}_{i,j,t} = MI_{i,j,t}$$

Literature

Dietzenbacher, E., Los, B., Stehrer, R., Timmer, M., and de Vries, G. (2013). The Construction of World Input-Output Tables in the WIOD Project. *Economic Systems Research*, 25(1):71–98.

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Steger, S. and Bleischwitz, R. (2011). Drivers for the use of materials across countries. *Journal of Cleaner Production*, 19(8):816–826.