EVALUATIONS ON CONSUMPTION-BASED CO_2 EMISSIONS IN EUROPE

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Overview

Relationships between GDP growths and CO_2 emission increases showed strong positive correlations until recently. However, for the recent several years, the correlations were not always observed, and it is pointed out that decoupling between GDP growth and CO_2 emission increase may start to take place in global and some developed countries. To examine why those emission trends were observed, we analyzed consumption-based emissions and evaluated the relevant potential factors. This paper focuses on consumption-based emissions for the European countries for 2010-2014. The result reveals that most of the European countries decreased production-based CO_2 emissions more than consumption-based emissions. That indicates that instead of increases in their production-based emissions, the emissions in developing regions (mainly China) increased through international trade to meet the demands in Europe. Therefore emission reductions observed in Europe does not largely contribute to considerable reductions at a global level. Exceptionally, Germany decreased consumption-based emissions as much as production-based emissions along with strong growths in exports.

Methods

Consumption-based emissions for 2000-2014 were estimated, based on methods of Peters et al. (2009), as follows:

$$ConsCO2(r) = EF(r)\big(\boldsymbol{I} - \boldsymbol{M}(r)\big)\big(C(r) + Iv(r)\big) + \sum_s (EFC(s)\boldsymbol{Im}(r,s)) + RCO2(r) \quad (1)$$

, where r and s are countries, $\boldsymbol{I}$ is identity matrix, $\boldsymbol{A}$ is input-output coefficient matrix, $\boldsymbol{M}$ is import coefficient matrix, EF is coefficients on production-based CO_2 emissions, EFC is coefficients on consumption-based CO_2 emissions, C *is* final demand, Iv is investment, $RCO2$ is direct CO_2 emissions of non-electricity in household, and $\boldsymbol{Im}$ is trade (import) matrix. The second term in the right side in Equation (1) represents CO_2 emissions embodied in import. This time coverage includes the periods which temporarily sluggish emissions at a global level. IEA (2017) for CO_2 emissions and WIOD (2016) as international input-output tables were used in this study. Production-based CO_2 emissions are emissions from combustions of fossil fuels generated inside the territory of the country, equivalent to common CO_2 emissions statistics like IEA and UNFCCC. On the other hand, consumption-based emissions are direct and indirect emissions generated to meet the domestic demand of the country, regardless of production sites. National consumption-based emissions include emissions embodied in imports and exclude emissions embodied in exports.

Results

Figure1 shows production- and consumption-based CO_2 emissions for EU28 and the major European countries. The emission differences calculated by subtracting production-based emissions from consumption-based correspond to emission embodied in net imports (imports minus exports). Most of the European countries have continually higher consumption-based emission than production-based. However, the time-series trends are different among countries. In EU28 total, U.K., and France, growths of consumption-based emissions were larger than those of production-based until 2008. While their production-based emissions decreased, the import amounts increased, and then the embodied emissions in imports also increased. The increases in emissions embodied in imports were mainly caused by increases in machinery imports from China. As a result, the European contributions to global emissions reduction were not large. After the financial crisis, the differences were shrinking. Although import amounts increased continuously, CO_2 intensities of imports in the production sites decreased considerably after the late 2000s. Exceptionally, Germany decreased consumption-based emissions as much as production-based emissions along with steady growths of exports.

Figure2 shows regional comparisons of CO_2 intensities based on consumption-based emissions and the emission differences. Most of the countries have similar trends on consumption-based CO_2 emission intensities

(ConsCO_2/GDP) based on real local currency. According to statistical tests, increases in electricity prices yield significant effects on increases in emission embodied in net imports in most European countries except for Germany.

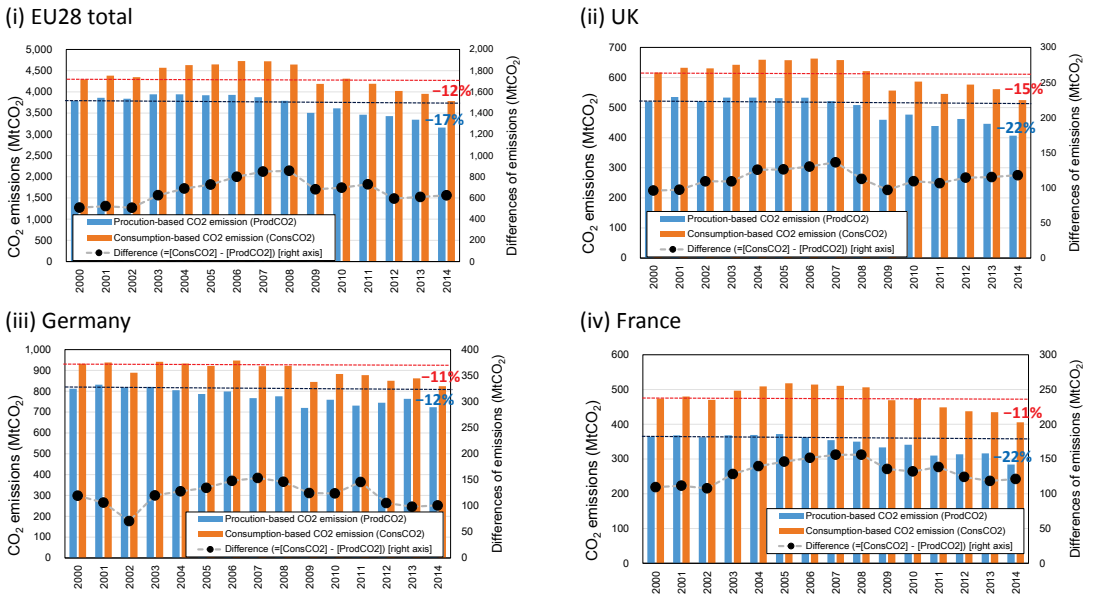

Figure 1. Production- and consumption-based CO_2 emissions for 2000-2014

Note: Blue and red values in the graphs represent change rates of production- and consumption-based emissions from 2000 to 2014, respectively.

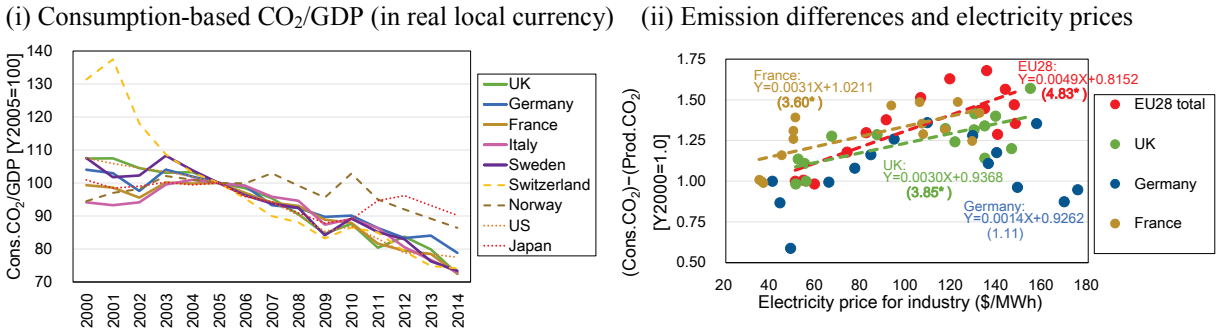

Figure 2. Regional comparisons of indexes related to consumption-based CO_2 emissions

Note: Values in brackets in (ii) are t-values. * represents a significance level of 0.05.

Conclusion

For 2000-2014, the estimated consumption-based CO_2 emissions indicate that decoupling observed in European countries except for Germany was caused by increases in import dependencies and then the emissions were transferred to other regions. Decoupling between GDP growth and CO_2 emissions at a global level is essential for sustainable climate change mitigation. Fundamental changes in consumption structures, that is the innovation of final goods and services, leading to globally harmonized measures, are necessary to achieve deep decoupling globally.

References

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